INTER AVIA

Review of World Aviation

In this Issue :

Red Stars in the Sky : Analysis of Soviet Air Power

DC-3, Super DC-3, Mamba DC-3...

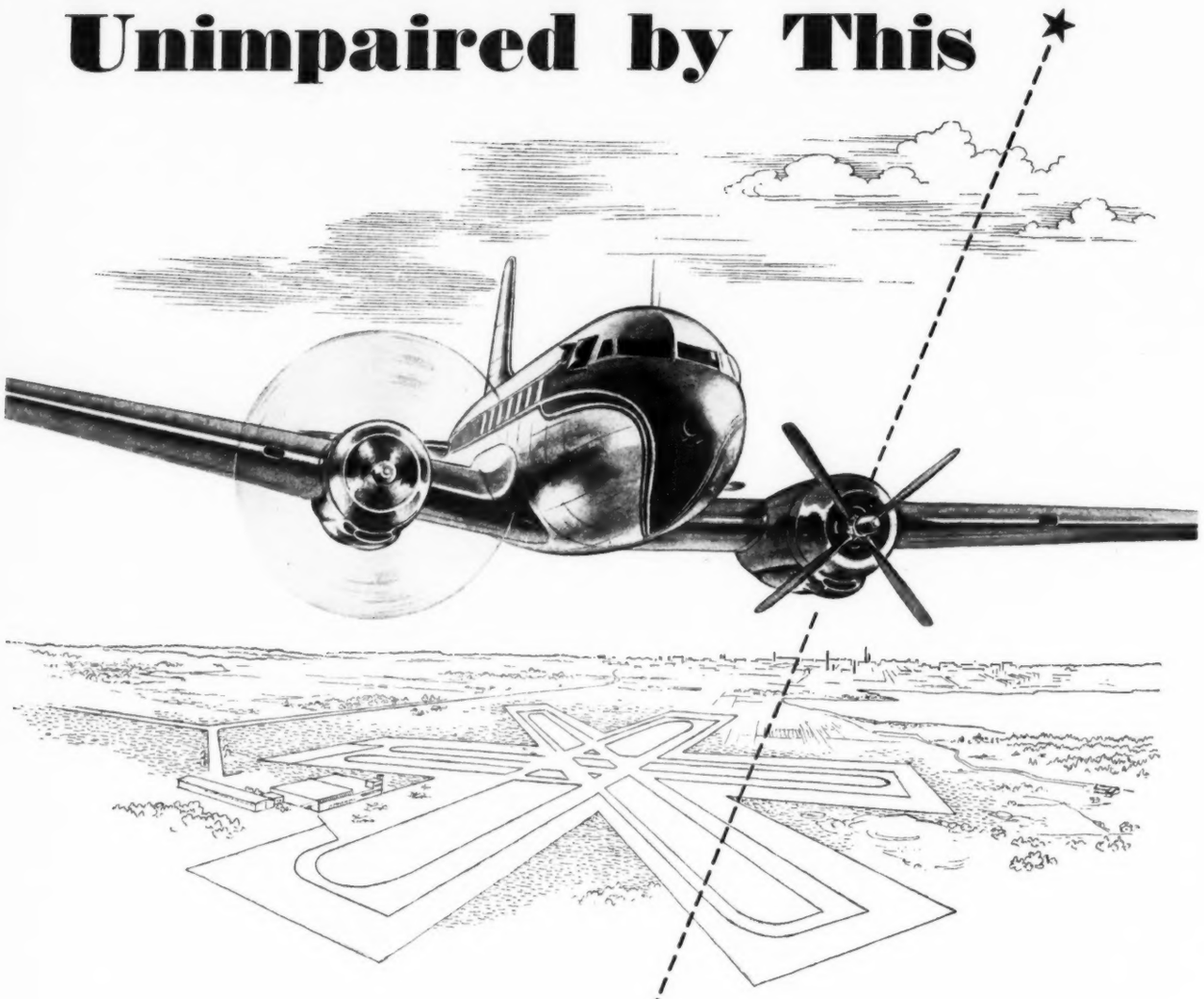
C. G. Grey : The British Aircraft Industry (Short Brothers, Ltd.)

W. Jucker : The Wandering Mountain—Sailplane Pilots' Paradise

Svend-Aage Nielsen : An Infidel Flies to Mecca

VOLUME IV No 11 NOVEMBER, 1949

Flight stability Unimpaired by This



SINGLE ENGINE PERFORMANCE:	
Service Ceiling, Max. Continuous Power, Weight 33,500 lbs	11,150 ft
(R/c = 0.02 . V_{so}^2 ft/min)	
Rate of Climb, Max. Continuous Power, Weight 33,500 lbs	
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Min. Runway Length, required by CAR	
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INTERAVIA

Review of World Aviation

OFFICIAL ORGAN OF THE FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE (F.A.I.)

Volume IV | November, 1949 | No 11

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Front cover:

Airborne pilgrims from India land at Mecca's airport.

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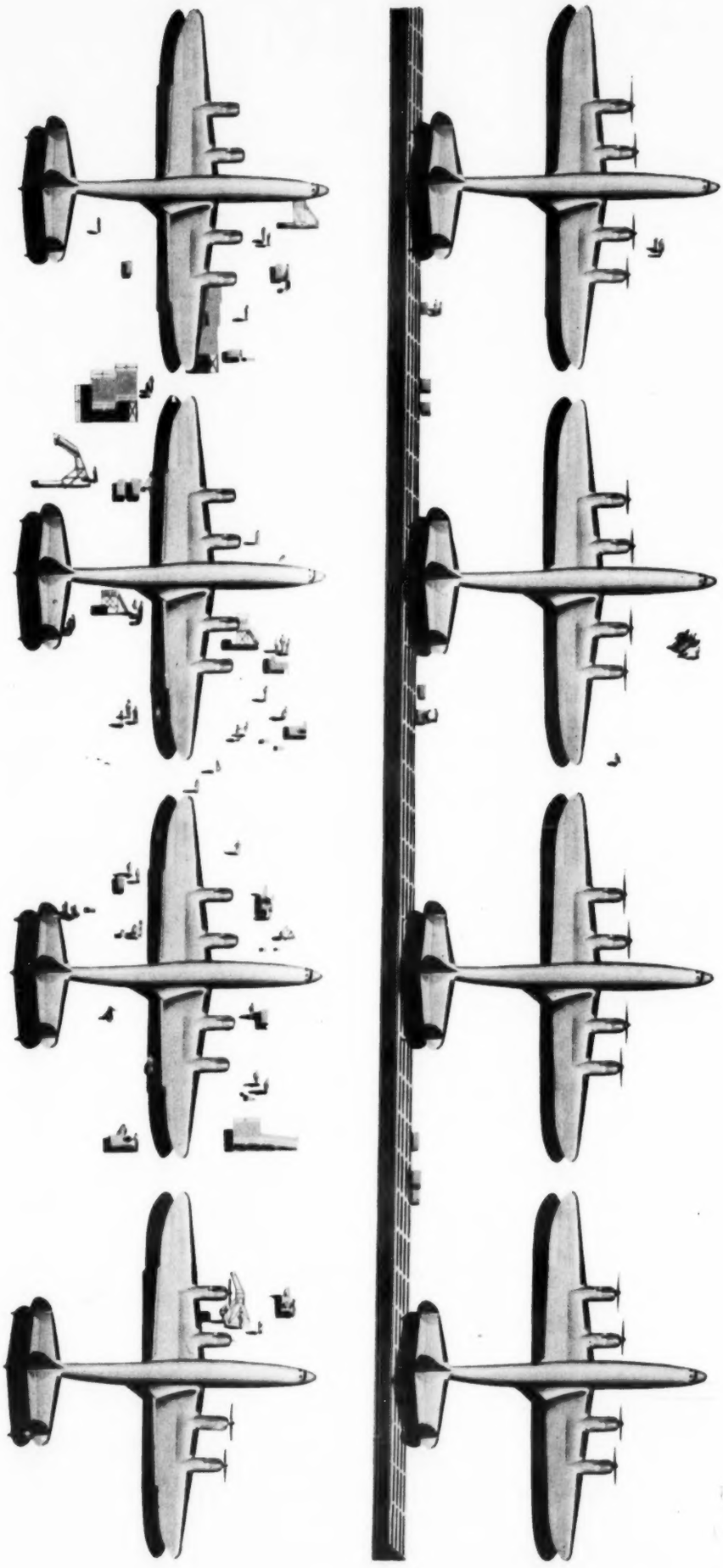
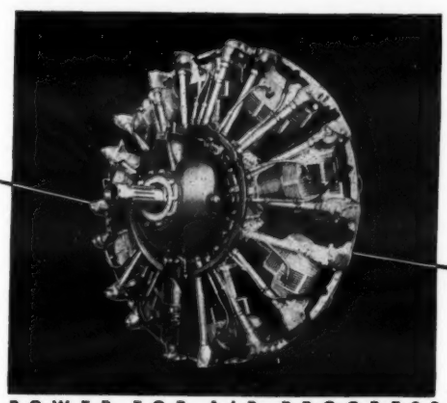


TAKING OFF TO MAKE NEW AVIATION HISTORY

... *the Cyclone-Powered Super DC-3*



POWER FOR AIR PROGRESS

It's a *high-powered* take-off ... because the Douglas Super DC-3's power plant is the CYCLONE 9HE ... *rated* at 1475 horsepower for improved take-off performance.

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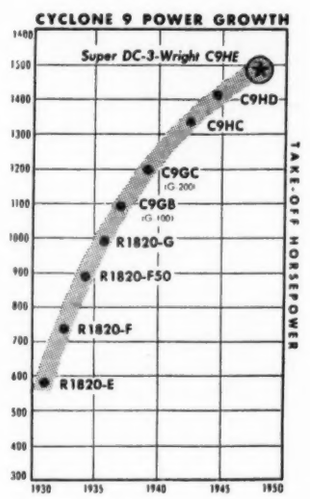

Today, the swift new Super DC-3 *takes off* with the Cyclone 9HE—with "9" *features that pay off aloft:*

1. **More power;**
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7. **Improved cylinder cooling;**
8. **Accurate power control** with Wright Torquemeter;
9. **A 16-year background** in airline service.

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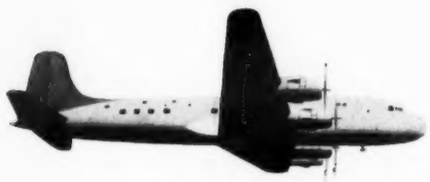

The reliability of Douglas aircraft is unequalled. Every day, thousands of Douglas planes in service on the airlines of the world prove this fact anew.

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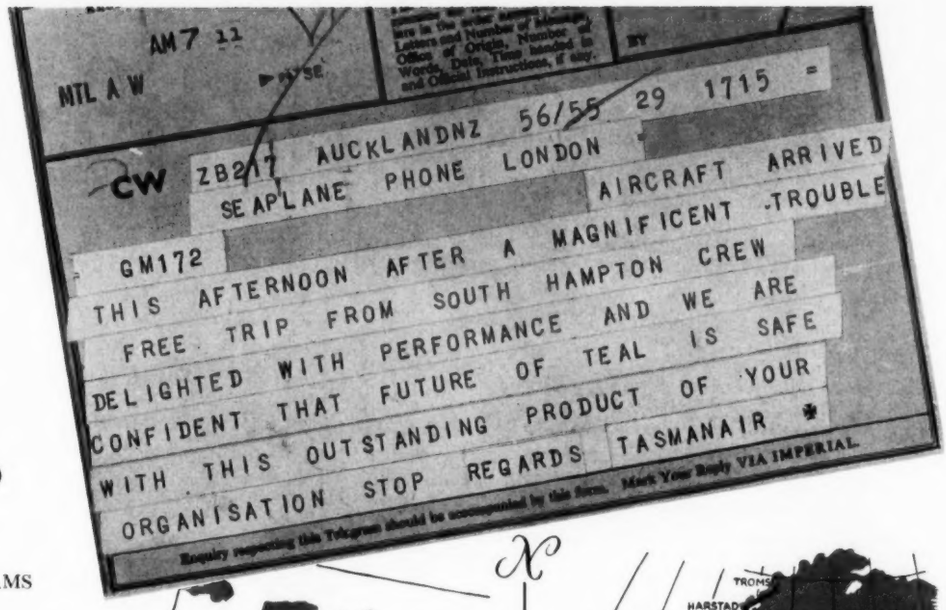
This cable from Tasman Empire Airways emphasizes international enthusiasm for Short flying boats

(See Para. IV)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AIRCRAFT ARRIVED -TROUBLE
Enquiry respecting this Telegram should be accompanied by this form. Mark Your Reply VIA IMPERIAL.

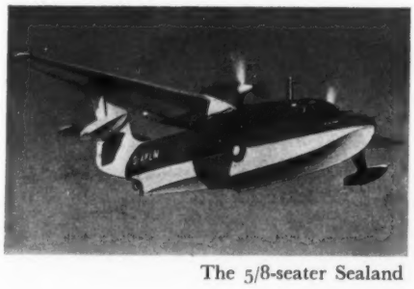
S.A.S.'s SANDRINGHAMS

Norway has the longest internal air route of any European country. It runs over an intricate pattern of mountains and fjords and reaches far into the Arctic circle. In this difficult area the flying boat is an invaluable means of transport, and S.A.S. are using Short Sandringhams to provide a regular service which has become indispensable to the people of the Northern townships. In the Spring and Summer S.A.S.'s 37-seat Sandringhams leave Oslo daily for Tromso, and the flying boats are nearly always filled to capacity; between April and August 19,400 passengers were carried — 1,000 passengers a week.

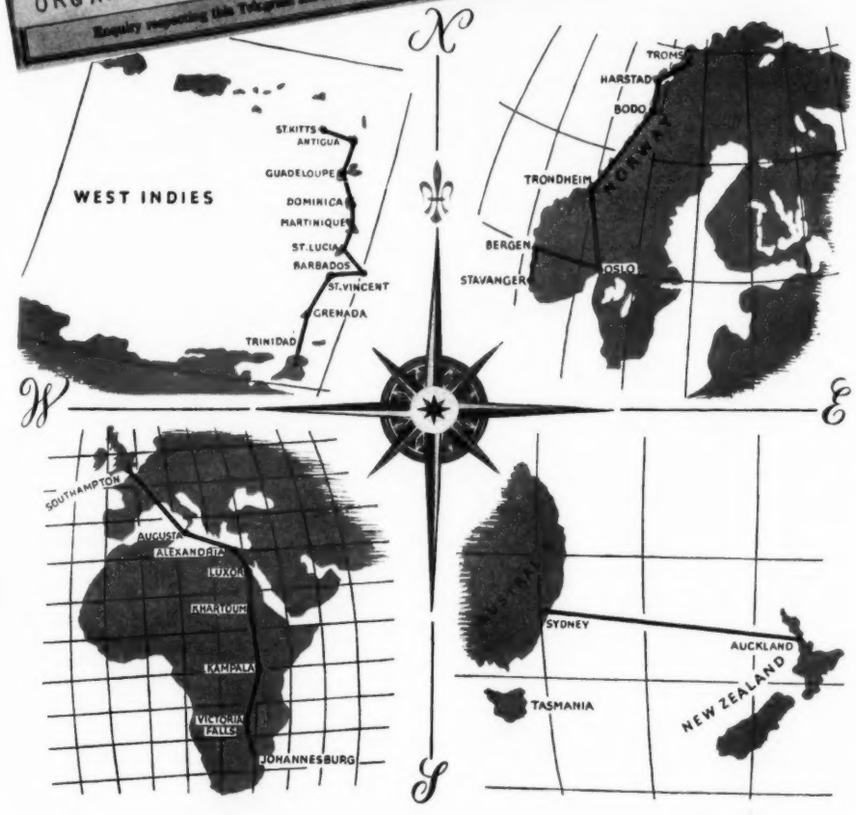
The 34-seater Solent

B.O.A.C.'s SOLENTS

On B.O.A.C.'s 'Springbok' service, running three times weekly from Southampton to Johannesburg, flying boats have opened up an inland route. B.O.A.C. is using the latest Short Solents, one of which was the first flying boat to land on the Zambesi River, just above the Victoria Falls. Putting down on lakes and rivers the Solent carries its 34 passengers into parts of Africa previously served by landplanes.



The 5/8-seater Sealand



B.W.I.A.'s SEALANDS

The Short Sealand will first see service in the Caribbean. British West Indian Airways have acquired three to operate their Sea Island Service. Up to now the smaller West Indian Islands, like Bequia and Cariacou, have only been erratically served by native schooners, but the Sealand, equally happy on land or sea and fitted out as a 'bus' or a freighter, will offer greatly improved means of communication. Twice weekly the Sealand, carrying eight passengers, will follow the arc of islands between Trinidad and St. Kitts.

T.E.A.L's NEW SOLENTS

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Down under, Tasman Empire Airways Limited, who have used Short flying boats during nine years of profitable operation, are adding four of these Solent IV's to their fleet. These 30 to 44-seater aircraft will cover the route between Sydney and Auckland, on which Short flying boats have long been running.

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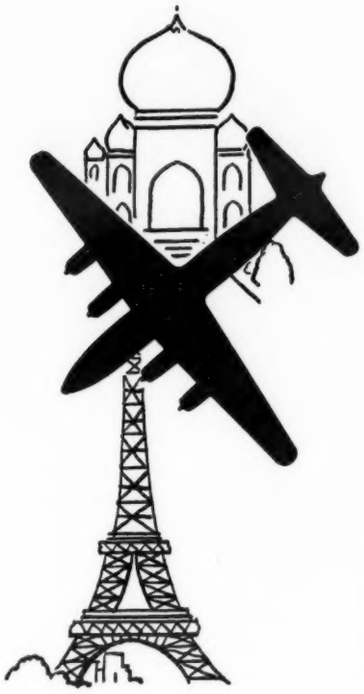

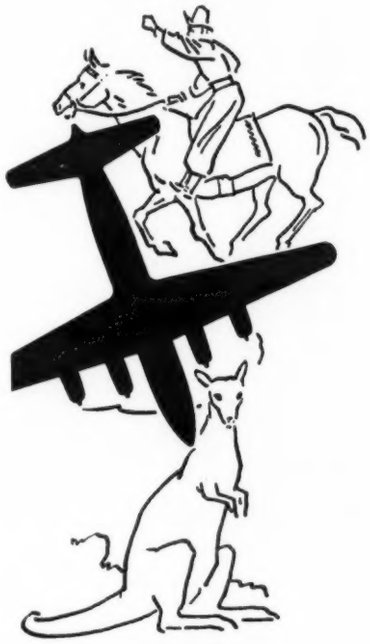

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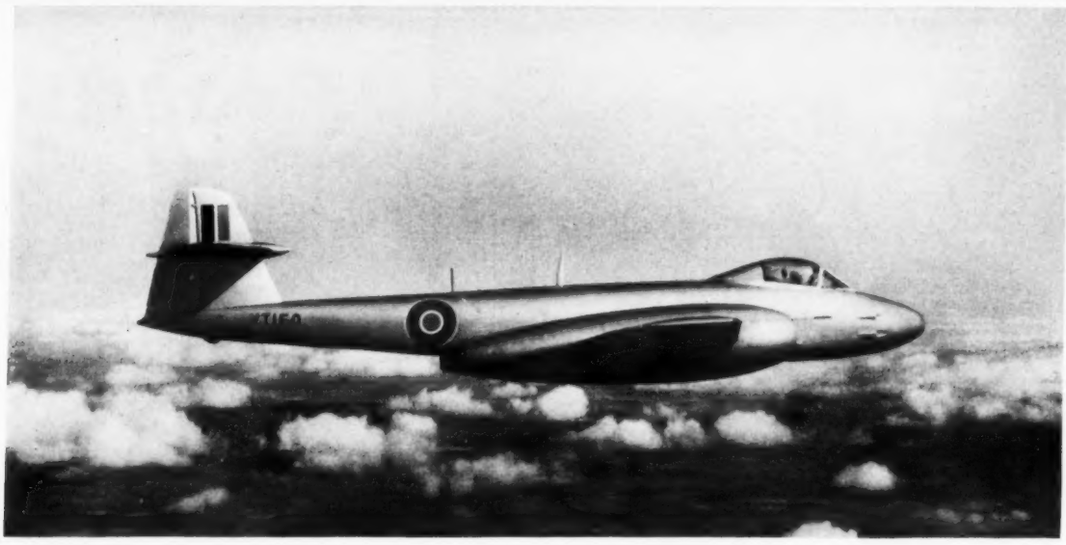

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Red Stars in the Sky

"Over everything today there looms and broods the atomic bomb." This statement of fact was made in the House of Commons on September 28th, 1949, by Britain's elder statesman, Winston Leonard Spencer Churchill.

"He who controls the air controls the destiny of the world," declared General George Churchill Kenney, then Commanding General of USAF Strategic Air Command, on May 7th, 1948. "The Communists will start 'Operation America' as soon as they feel they can win a conflict against us . . ."

"Russia is the birthplace of aerial navigation. To her belongs undisputed priority in discoveries and inventions in the sphere of aviation." Thus wrote the Moscow "Pravda" on July 17th, 1949.

The three statements were made at widely separated places on widely differing dates, but they are closely related. Churchill specifically alluded to the Russian atomic bomb, the apparent existence of which was disclosed by the U.S., British and Canadian Governments on September 23rd, 1949. Kenney's claim took it for granted that any air force "controlling the destiny of the world" has the atomic bomb at its disposal. And "Pravda" once again underlines the known fact that Soviet Russia is aspiring to become the world's strongest military air power as part of her effort to bring the entire globe under her direct or indirect influence.

At the present stage of scientific development possession of the atomic bomb is decisive *only* if means of delivery are available. Hence, the present and the potential strength of the Soviet Air Force are important factors in top-level international politics.

The leaders of the Soviet Union, who never place their cards on the table, are fully aware of this fact and therefore surround the activities of their air arm with an almost impenetrable veil of secrecy. All the same, an attempt will be made in the following pages to assess Russia's strength in the air, on the basis of available but admittedly inadequate data.

THE SOVIET AIR FORCE

Numerical Strength of the Air Force

More than any other nation in the world, the Soviet Union has traditionally given priority to the development of her land forces over the air arm ; the third branch of her armed forces, the Navy, was completely neglected. Whether this policy paid off in World War II or whether a stronger Russian Air Force could have shortened the war or at least minimized the Red Army's incredible losses in the early stages of the conflict is an open question. The fact remains that despite the catastrophic destruction inflicted on Russia's industrial areas, the Soviet's initial weakness in the air was gradually eliminated over the years, and by the end of the war the Soviet Union had a large, efficient tactical air arm of some 25,000 first-line aircraft. However, the Russian claim that 75,000 out of the 80,000 aircraft built by the Nazis during the last three years of the war were destroyed on the Russian fronts need not be taken too seriously.

Reports seeping through the Iron Curtain indicate that since the end of the war the Russians have concentrated a major part of their military effort on the maintenance of an "aerial steamroller," not only to supplement their "traditional steamroller" on the ground but also to meet the strategic requirements of air warfare. That the war-time concept of the air arm as a mere auxiliary to the ground forces is being subjected to modification, although not elimination, is shown by the fact that of Russia's 1948 military budget no less than 58 percent has been earmarked for the Air Force. The 1949 and 1950 percentages are unlikely to be smaller.

Conservative estimates placed the strength of the Soviet Air Force as at the beginning of 1948 at approximately 16,000 operating aircraft, including 9,000 first-line combat machines. Significant is the fact that at that time Russia's air strength already comprised 400 four-engined long-range bombers of the Tupolev Tu-70 (B-29) type. Another 20,000 aircraft, some of them obsolescent war-time types, were believed to be in "moth-balls" as a second-line reserve. While the precise strength of the Red Air Fleet is just one of the Russian mysteries, it was competently estimated that in the middle of this year it amounted to about 25,000 first-line aircraft and 550,000 men. This strength included about 10,000 jet-propelled fighters and 2,000 long-range bombers ; the rest were made up of short-range bombers, single-engined attack bombers, piston-engined fighters, transports, etc. There were also several thousand trainers and a second-line reserve of about 18,000 piston-engined war-time aircraft.

Modern Equipment

Standard equipment of the Soviet Air Force's first-line squadrons is excellent by any yardstick. Piston-engined fighters include such types as the Lavochkin La-11, which is comparable to the German FW 190 and, therefore, a match for America's F-51 "Mustang" or F-47 "Thunderbolt"; it also equals Britain's "Spitfire" and is hardly inferior to the Hawker "Fury." Some of the jet fighters are at least equal in performance to the "Vampire" or F-84 "Thunderjet." The Tupolev Tu-70 long-range bomber, a modified copy of the Boeing B-29 "Superfortress," probably is a cut below the B-29's development, the new Boeing B-50, and other new American types ; no doubt it is superior to Britain's obsolescent "Lincolns" and "Lancasters." Principal types now in squadron service are these :

Piston-engined fighters : Lavochkin La-9 and La-11 in large numbers. The La-11 resembles the German FW 190 and no doubt is the last piston-engined fighter to be adopted. Smaller numbers of Yak-9 and Yak-11 fighters are also in service.

Jet fighters : The Mig-9 twin-jet type constitutes the bulk of Soviet jet fighter strength but has now been supplemented by considerable numbers of Yak-21 rocket fighters, a development of the German Messerschmitt Me 163. The Yak-15, which was built in large numbers (the Russians claim since the end of 1943), is still a first-line aircraft but now is largely used for training purposes. The Yak-17 has taken its place in some squadrons. A new single-engined Lavochkin swept-wing fighter is in limited service and the twin-engined Lavochkin La-15 fighter will shortly be issued to squadrons.

Officer cadets on parade in Moscow.

"Red Stars": Tupolev Tu-2 light bombers of the Soviet Air Force. A twin-jet bomber has now been developed by A. N. Tupolev.

Bombers: Increasing numbers of Tupolev Tu-70 four-engined bombers (Chinese copies of the Boeing B-29 "Superfortress") are being supplied to squadrons of the Long-Range Bombing Force. A bomber version of the four-engined Ilyushin Il-18 transport is also reported but apparently has not yet been issued to squadrons. Large numbers of Tupolev Tu-2 twin-engined light bombers are in operational use, and a twin-jet attack bomber has been developed by the same designer. Finally, the Ilyushin Il-16 four-jet bomber has been flying for more than two years and reportedly is about to reach the operational stage.

Attack aircraft: The Ilyushin Il-10 "Stormovik" single-engined type is the mainstay of the Red Air Fleet's ground attack forces. Large numbers of the wartime Pe-2 twin-engined type are also still in service, as are the earlier Ilyushin Il-2 "Stormovik" and the Yak-4. A second-line attack aircraft is the Yer-2.

Transports: Large numbers of Ilyushin Il-12 twin-engined transports are in use as paratroop and cargo carriers. Some four-engined Tupolev Tu-70s are also in service, as well as a number of Pe-8 four-engined transports (formerly known as the Tupolev TB-7 bomber), licence-built Li-2s (DC-3s) and Lend-Lease C-47s (DC-3s).

Trainers include a two-seater version of the La-7 piston-engined fighter, Yak-20 advanced, Yak-18 basic and UT-2 primary trainers.

Soviets think in Global Air Strategy

From an organizational point of view, the Soviet Air Force last July consisted of about fifteen Air Armies with somewhat more than 1,000 operational aircraft each, the Long-Range Bomber Force, and the Fighter Arm of the Air Defence Force. Altogether these forces were made up of about 550 Air Regiments with about 40 aircraft each. The Air Armies, accounting for over 60 percent of Russia's air strength, form the "aerial steamroller" and are under the direct control of land Army or Army Group Commanders. The fact that just under 40 percent of the Soviet Air Force is now assigned to offensive and defensive strategic missions demonstrates the changes which Russia's military aviation doctrine has undergone.

That Stalin's air experts are thinking in terms of global air strategy is also reflected in the renewed importance they have attached since the end of the war to the concept of using the route over the top of the world, via the North Pole, to bomb the industrial areas of their most powerful potential enemy, a concept which many Americans have fondly imagined to be their monopoly. In actual fact the Russians saw the significance of the "Polar bombing route" long before the Western air powers and carried out "proving flights" even before the last war: on June 18th to 20th, 1937, an ANT-25 single-engined aircraft piloted by Chkalov, Baidukov and Beliakov (the last-named now is a Soviet Air Force general) flew non-stop from Moscow over the North Pole to Portland in the State of Washington; on July 12th to 14th of the same year Gromov (now also a General), Yumachev and Danilin flew a similar aircraft non-stop from Moscow to San Jacinto in California; and on August 12th, 1937, Levanevsky and five companions set out from Moscow aboard a four-engined transport to fly non-stop via the North Pole to New York but disappeared somewhere off Alaska.

YAK-9 (foreground) and LA-7 (back row, right) fighters on a Russian airfield. Tu-2 light bombers in background. The latest Lavochkin fighter is the LA-11, which has a 2,500-h.p. radial, three 20-mm cannon, 500 m.p.h. top speed. Numerous squadrons are equipped with it.

Ilyushin IL-3 "Stormowik" attack aircraft in flight.

As part of their global air force policy, the Russians have established a number of large bomber and fighter bases in the North of the Soviet Union. Several are known to be on Novaya Zemlya. The thoroughness with which they are preparing their "over-the-top" strategy is disclosed by the facts that one Division of the Long-Range Bomber Force is trained especially for Arctic bombing ; that Soviet scientists have been recruited to facilitate the supply problem in the Northern regions by developing grain, vegetables and fruits flourishing even in the rigours of the climate prevailing north of the Arctic Circle ; and that they have set up 81 air weather observation posts in the Arctic region alone.

Emphasis on Airborne Forces

Thus it is evident that the Russians are bringing their military aviation thinking up to date by embracing the latest doctrine of global air strategy. That they are not simultaneously making the error—of which the USAF has recently been accused—of neglecting the tactical components of their air arm is evident from the composition of their air forces, as outlined above.

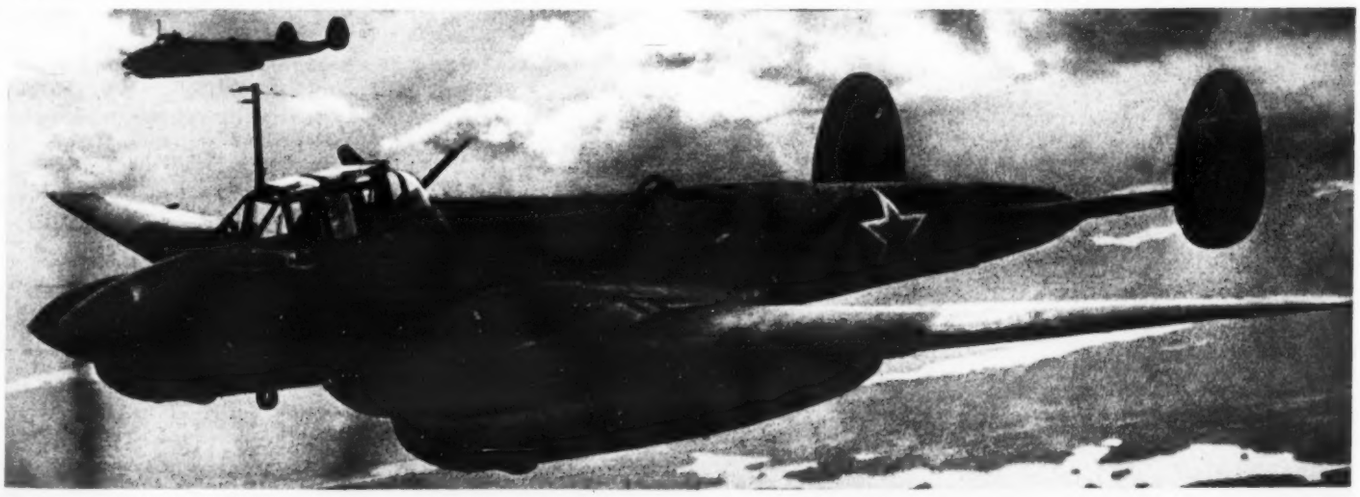
Since the end of the war they have also paid increasing attention to one type of warfare which they had pioneered in the thirties, and subsequently neglected, namely, attack by airborne forces. Mass parachute drops were organized during the Soviet Army manoeuvres in 1934 and 1935, and large formations of troops, complete with tanks and guns, were moved by aeroplane from European Russia to the Soviet Far East as long ago as 1936. However, during World War II the Russians made little use of airborne forces, apart from those that were landed to assist Russian partisans behind the German lines.

In post-war years the training of parachutists has assumed very large proportions, both in the guise of a national "sport" and in the Army proper. Mammoth parachute displays were held on Soviet Air Force Day in 1948 and 1949. Much importance is also being attached to the carriage of troops, equipment and supplies by cargo glider, as was shown by the glider train which flew over Tushino Airport at the conclusion of the 1948 air display in Moscow.

At the beginning of 1949 the Russian Air Force was estimated to have about 3,000 transport aircraft in service, mostly twin-engined Ilyushin Il-12s. Russia also had about 150,000 trained parachutists at its disposal. The aircraft industry has developed a number of modern cargo gliders. Some of these are in use with the Air Force, others are subjected to protracted operational testing by the "civil" airline administration.

The latest transport glider is that designed by Engineer P. B. Taybin, which carries a useful load of 5,500 lbs. or about 20 fully-equipped troops. Another type, the KC-20 designed by Engineers Kolesnikov and Cybin, features a twin fuselage with monocoque tail booms and twin rudders. Its carrying capacity is just over two tons (or 20 fully equipped troops). The type was first tested by the Air Force and is now used for civil cargo operations on the Moscow-Novosibirsk and Gorki-Kuibyshev routes. The G-11 cargo glider developed by Gribovski is reported to be used for passenger services in Central Asia, notably in the region of Ashkhabad. Finally, the Antonov A-7 cargo

Petlyakov PE-2 light bombers.



A new type of Lavochkin swept-wing jet fighter flashes by at Moscow's air parade of 1949.

The MIG-9 fighter - the Soviet Air Force's best.

glider, with a span of 63 ft. and a length of 38 ft., has seen service since 1944, when it was used to supply Soviet guerillas behind the German front.

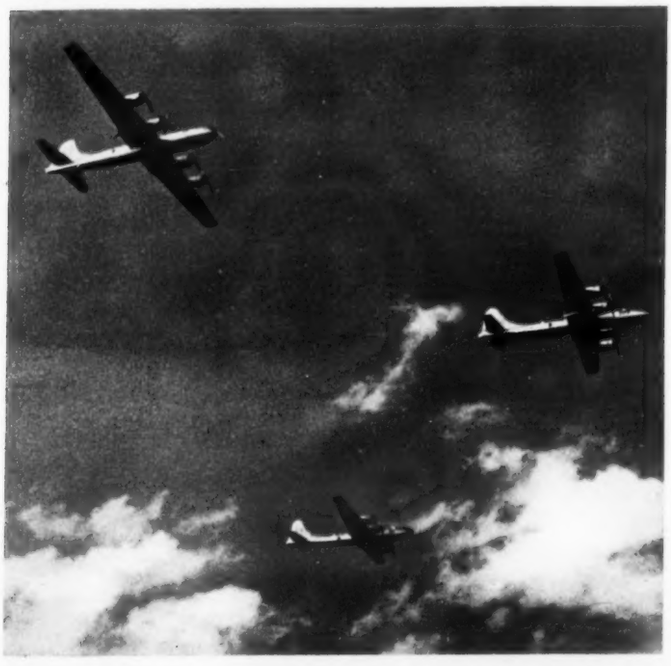
Pilots are well trained

In spite of reports to the contrary, flying training standards in the Soviet Air Force are not inferior to those set by the U.S. Air Force or the Royal Air Force. Training curricula absorb approximately the same amount of time as in England and the U.S.A. Some of the training results are demonstrated annually at the Tushino air display, near Moscow, and foreign observers are unanimous in their praise of the Soviet airmen's flying skill. Training of women pilots continues on a large scale, both for combat, transport and auxiliary duties.

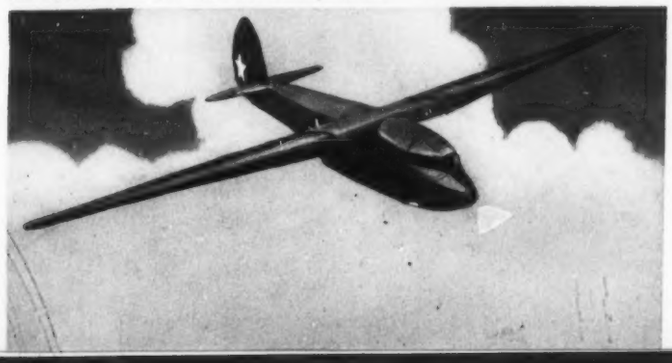
Officers ranking from squadron commander upwards receive advanced training at the Red Air Force Academy at Monino, near Moscow, Russia's largest air force officer training school. Air Force officers are also trained in special divisions of the Voroshilov General Staff College, the Voroshilov Naval Academy and the Frunze Military Academy.

Air Force engineering officers are trained at the Zhukovski Aeronautical Engineering Academy in Moscow, the Kuibyshev Armed Forces Engineering Academy and the Riga Air Force Engineering College. While officer engineering training reaches a high level, the training of non-commissioned maintenance and repair personnel is deficient by Western standards, which might prove a serious drawback in any conflict involving the operation of the Air Force's new, complicated equipment.

Substantial numbers of Tupolev Tu 70 heavy bombers—Chinese copies of the USAF's Boeing B-29 "Superfortress"—are in service with the Soviet Air Force. The Tu 70 has a top speed of 320 m.p.h., a range of 2,500 miles, is powered by four 2,200-h.p. radials.



The Antonov A-7 is one of several troop transport and cargo gliders used by the Soviet Air Force and the Civil Air Fleet Administration.



The Top Brass

Commander-in-Chief of the Soviet Air Force is Marshal Constantin Vershinin, who assumed his appointment on March 20th, 1946. Foreign reports have asserted that Vershinin is merely a figurehead and completely dependent upon the "land marshals" in any decision he may wish to make. There is no evidence to support this view, however, and Vershinin seems to be as autonomous as any individual branch commander in a closely-knit combat team can be expected to be. Vershinin's able right-hand man is General Sudets, Chief of Air Staff, whose principal planning officers are Colonel-General Nitkitin and Major-General Perminov. The Fighter Arm of the Air Defence Force is commanded by Major-General Vasili Stalin, son of the dictator, and the Long-Range Bomber Force—formerly the Sixth Air Army in Siberia—is under the command of General Golovanov. The Siberian air forces are now commanded by General Shegelev. The Air Material Division, including raw material procurement, is run by Colonel General Repin. An important advisory role is played by Marshal Fedor Astakhov, Director-General of the Civil Aviation Administration, whose vast network of air routes and large air fleet would be an invaluable auxiliary in times of war.

Weaknesses . . .

It is quite obvious that an air arm as young as the Soviet Air Force —an air force is as old as the industry behind it—still has its defects. However, continued and apparently successful efforts are being made to remedy the Red Air Fleet's remaining weaknesses.

These are, notably, the following :

(a) Lack of experience in the design of long-range bombers. The present Tu-70 bomber is at best a step or two behind the USAF's B-50 and B-36.

(b) Lack of experience in long-range strategic bombing. The Russians may make up for this easily enough, however : they have a practice range extending from Eastern Germany to Petropavlovsk—about 5,000 miles.

(c) Lack of night fighters.

(d) Deficiencies in air defence coordination, including fighter control, anti-aircraft control, air raid warning system and defensive radar warning system.

(e) Deficiencies in the training of technical maintenance personnel.

But the most glaring defect in Soviet air power is the neglect of the naval air arm. The Russians have recently strengthened their Navy by the addition of two new battleships and a number of Italian vessels. They are also building a large fleet of modern submarines. But they possess only one single, small unit of what World War II has shown to be the "backbone of the fleet"—the aircraft carrier. The solitary vessel is the 12,000-ton "Krasnoye Znamya," which has a capacity of forty aircraft. Altogether the Russian Navy has 2,500 aircraft, mostly patrol bomber types ; included in this figure are approximately 250 obsolescent Ilyushin Il-4 twin-engined torpedo bombers.

An Efficient Striking Weapon

Despite these deficiencies it is a matter of record that the Soviet Air Force has ceased to consist of large quantities of outmoded wooden aircraft powered by engines of questionable performance and piloted by fatalistic mujiks who would prefer to sit around a stove drinking vodka. Although as late as the end of the war the Soviet Air Force was more notable by its numbers than its quality, it has since been turned into a thoroughly modern, hard-hitting weapon, on which continuous improvements are being made. Indicative in this respect is the fact that radar equipment is shortly to be fitted to all aircraft of the Long-Range Bomber Force. In all likelihood the Soviet Air Force is numerically stronger today than the U.S. Air Force and the Royal Air Force combined and thus already represents a weighty factor in international politics.

THE AIRCRAFT INDUSTRY

Much Maligned but Vigorous

The Soviet aircraft industry has been much maligned in recent years, chiefly by people who would have been delighted to see it flounder in the alleged incompetency of its designers and production experts. The fact remains that the opposite has happened. Soviet industry is producing modern aircraft in large numbers. True, the Russians have not created a B-36, C-99 or "Constitution" nor even transports like the "Constellation," "Stratocruiser" or "Convair-Liner." Nor have the British, for that matter, with the exception of still untried types such as the "Brabazon," "Comet," "Ambassador" and a few others, and yet nobody will assert that the British aircraft industry is out of date. The Soviets have in quantity production such solid, conventional transports as the twin-engined Ilyushin Il-12 and the four-engined Il-18, and for the non-competitive Russian domestic services and even certain foreign routes (CSA, LOT) as well as for military transport duties they are eminently satisfactory.

In addition they have in squadron or experimental use about a dozen different types of jet-propelled aircraft ; most of these are of purely Russian design, although some may have been "inspired" by German or other foreign projects. A four-engined jet-propelled medium bomber "Il-16" and a twin-jet light bomber (Tupolev) will shortly be issued to Air Force units.

Early in 1949 the Soviets had 150,000 trained parachutists.

Pilot morale is excellent.

An industry able to boast such results can hardly be described as under-developed. The truth simply is that under the Soviets' first post-war five-year plan industrial production has recovered in an astounding degree, in spite of the widespread havoc wrought in the Union's industrial areas by the war. Thus, steel production for 1948 totalled 16,000,000 tons, compared with 18,300,000 tons in the last pre-war year, 1940 (and about 80,000,000 tons in the U.S.A.) Crude petroleum production will reach about 40,000,000 tons next year, which is considerably in excess of the 1940 output.

Since the end of the war the Russians have concentrated one of their major efforts on the production of aluminium for the aircraft industry, partly in order to replace the liberal Lend-Lease aluminium supplies they received from the Americans during the war. The largest bauxite

The Soviet Air Force has about 3,000 paratroop and cargo transports, mostly Ilyushin IL-12s. Photo shows dozens of IL-12As and IL-12Bs (with extended dorsal fin) at Vnukovo airport, Moscow.

Air Force Guard Lieutenant-General Vasili Stalin, Commander of the Fighter Arm of the Air Defence Force and son of Uncle Joe.

Steel output for 1948 increased to 18 million tons.—The steel plant at Kertch.

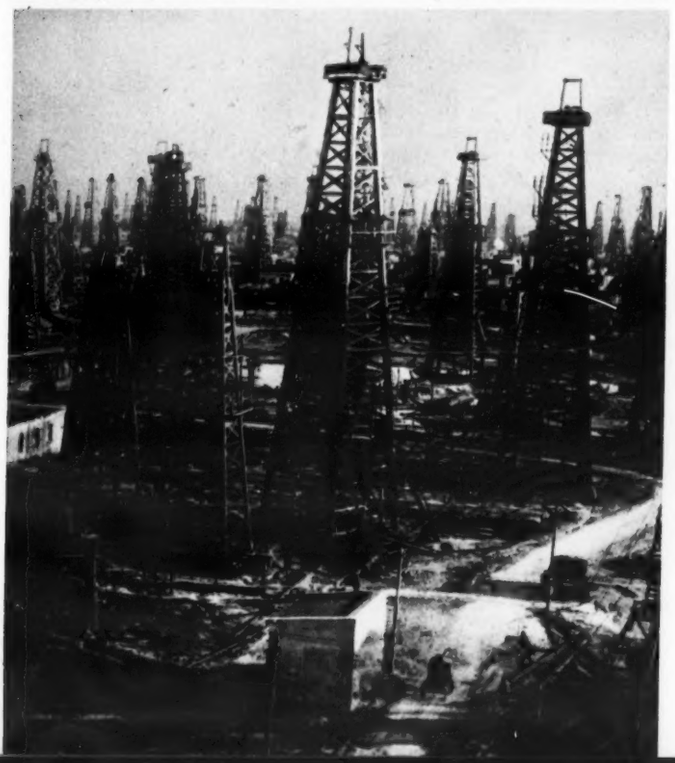
deposits now being exploited are situated in the Northern Urals, as well as in Western Siberia and in the vicinity of Leningrad.

At least eight major aluminium plants with an estimated total of 140,000 workers are at present engaged in the production of aluminium for the exclusive use of aircraft factories. One of the largest is that situated at Krasniturinsk, in the Northern Urals, 200 miles northwest of Sverdlovsk, which was begun in 1944 and now employs 30,000 workers. Its labour force is gradually to be doubled. An even greater plant has just been completed at Uass, also in the Urals. Other known factories are the 20,000-man plant at Stalinsk, in Western Siberia ; the plants at Turinsk, near Sverdlovsk ; Irgis, 600 miles west of Stalingrad ; and Omsk.

Thirty-seven plants, 440,000 workers

The aircraft and engine industries proper went through a relatively stormy period of initiation in the years that followed their creation under a German-Russian agreement of 1922. This agreement provided for the establishment of a Junkers shadow plant at Fili, near Moscow. The development of the young industry was personally supervised by General Yakov Alksnis, aviation assistant to Marshal Tukhachevski. Unfortunately for the industry (and for the persons involved), they were both liquidated, together with Todorsky, head of the Zhukovski Aeronautical Engineering Academy, during the 1937 monster trials. In the ensuing purge numerous leading production experts, technicians and designers (including A. N. Tupolev, who has meanwhile been rehabilitated) were eliminated, which nearly wrecked the industry. Luckily, however, the aircraft industry had regained its equilibrium by the time of the Nazi attack in 1941.

Petroleum production is to reach 40 million tons next year.—The oil fields of Baku.



Today the Russian airframe industry counts at least twenty-five major factories with a labour force of more than 350,000 people. The aircraft engine industry has about twelve major plants employing 90,000 workers. In comparison, the U.S. airframe industry last April employed about 170,000 people ; U.S. aero-engine plants, 41,500 workers.

Most of these plants are very large and modern. The majority are located in European Russia, notably the Volga Valley, and reports that the whole industry is being shifted to points behind the Urals should be treated with caution. There is no doubt, on the other hand, that some have been transferred to the new industrial areas in Turkestan ("Atomgrad"), Siberia, (Miussinsk, Kolymsk), the Lake Baikal region (Kuibyshev IV, "atomic industry") and the Soviet Far East.

The major known airframe production facilities are the Ufa plant in Moscow, which now has about 20,000 workers and is said to be capable of producing 10,000 aircraft a year in an emergency ; the original Fili plant in Moscow employs approximately 15,000 workers, the Stupino factory, northwest of the capital, about 10,000. A very large plant, with about 31,000 workers, is operating at Tiflis. The Stalin works at Kuibyshev concentrates on the production of jet fighters. Other known airframe plants and their labour forces (where available) are : Tashkent, 18,000 ; Zhumikha, east of Chelyabinsk, 9,000 ; Gorki, 7,000 ; Repinsk, east of Gorki, 6,000 ; Kiev ; Kharkov ; Saparozhe ; Taganrog ; Riga ; and Chkhalov, in the Urals, 11,000.

The largest of the aero-engine works, with 20,000 workers, is situated at Chernigovka, near Ufa. Others are the Kuibyshev plant, which specializes in jet engines ; the huge works at Stalinskaya, north of Moscow, which, under the management of Mikulin, the piston engine expert, concentrates partly on experimental work ; the smaller factory at Tushino, near Moscow, which has only 2,000 employees (including numerous German technicians) and apparently specializes in the development of jet and rocket engines ; the 10,000-man plant at Stalingrad ; a plant just completed at Voronezh, which employs about 8,000 people, and the factory at Molotov, in the Urals, with another 7,000 workers.

Facilities of the allied industries notably include the optical instrument and the plexiglass factories at Leningrad ; the precision instrument plant at Kuibyshev IV, in the Lake Baikal area ; the electronics instrument manufacturing plants at Kuibyshev, Kiev and Krasnogorsk (the last-named city produces gun sights, bomb sights, etc.), and the plexiglass factories at Zershinsk, 25 miles from Gorki. Whilst it has been the Soviet Government's policy not to enlist the industries of the Eastern European satellites in the Russian aircraft production effort—except for the manufacture of a few components—the well-developed precision industries of Czechoslovakia and Poland are believed to be supplying some of the Soviets' needs for precision-engineering products.

How high is Russia's production ?

Estimates of the production attained by this vast Russian aircraft industry vary widely, depending upon the individual who makes them and the purpose for which they are intended. U.S. Air Force Secretary Stuart Symington's warning to the Senate of April 13th, 1948, that the Soviet Union was building twelve times as many military aircraft as the United States doubtlessly was an exaggeration calculated to persuade U.S. legislators to adopt the Secretary's recommendations for a much-enlarged USAF.

It is a known fact that in each of the last two years of the war a Russian aircraft labour force of about 750,000 people turned out about 40,000 aircraft. The aircraft types then in production admittedly were of relatively simple design and of small size, whereas up-to-date, complex machines, requiring a greater effort in terms of man-hours, including jet-propelled aircraft and heavy bombers, are being produced today. This production disadvantage is offset, on the other hand, by the fact that the Russian aircraft industry is no longer disrupted by the war, that it has been able to procure substantial quantities of tooling machinery, both of Russian manufacture and from dismantled German plants (the Soviets captured the Messersehmitt factories at Wiener-Neustadt, Gotha, Schluckenau, Kolin and in Silesia ; the giant Junkers plant at Dessau ; the Heinkel works at Rostock and Oranienburg ; the Arado plant in Berlin-Babelsberg ; the Dornier factory at Wismar, the BMW plant at Eisenach, two Henschel aircraft factories, several Siemens, Telefunken and Askania instrument and electronics plants, etc.), and that it has obtained the services of large numbers of German production experts.

On this basis reports stating that in 1949 the Russians will produce roughly 25,000 aircraft seem reasonable. This compares with about 12,000 units for the U.S. aircraft industry (including about 4,000 combat aircraft). Russia's production can be broken down approximately as follows :

Heavy bombers	3,000
Light bombers.	5,000
Jet fighters	5,000
Conventional fighters	2,500
Transports	2,500
Utility aircraft, trainers, "Sports" aircraft, gliders	7,000
Total for 1949.	25,000

This means that production, which had fallen off sharply in 1946 and 1947 owing to the industry's conversion to modern types, will have increased considerably from the 1948 output of 18,000 units (2,000 heavy bombers, 4,000 light bombers, 6,500 fighters, 1,500 transports, 4,000 others). It is also possible that in 1950, when the Air Force will have reached its designed strength, the rate of aircraft production will be slowed down in order to release funds for much-needed improvements to the Air Force's ground organization.

Here again it should not be imagined that the relatively young Russian aircraft industry has solved all its problems. It is known, for example, that the Russians have run into considerable trouble with their jet-engine production. In the immediate post-war years the Russians had great difficulty in developing their own gas-turbine engines from the relatively unproven Jumo 004 and BMW 003 units they captured in Germany. They seem to have overcome most of their initial worries, however, no doubt partly because their engine designers got an unhoped-for boost at low expense when the British Labour Government agreed to sell them about fifty Rolls-Royce "Derwent" and "Nene" engines. The short-term performance of Russian-built jet engines is no doubt comparable to that of operational engines in other countries. The between-overhaul periods are another question, however, and impossible to assess. In spite of the Russians' rapid progress in the past few years, some sources claim that in the gas-turbine field they are still about three years' behind the British. Another major difficulty of Russian aircraft production lies in the field of precision instrument and electronic equipment manufacture.

Russia's Latest Jets

Mikoyan & Gurevich MIG-9 : This twin-engined single-seater fighter, with a straight wing and single rudder unit, is the best Soviet jet fighter in squadron use. Production was started in 1946. It is of mid-wing configuration and features a double nose air intake. The exhaust nozzles of the two axial-flow turbojets (possibly a development of the German BMW 003 or Jumo 004) are located side-by-side under the fuselage. Armament includes one 30-mm cannon, two .5-in guns in the nose.

Mikoyan and Gurevich have completed an improved development of the MIG-9. It is a single-seater shoulder-wing type with a tadpole-shaped forward fuselage housing two jets side-by-side. No other data are available.

Yakovlev YAK-15 is a single-seater single-jet straight-wing fighter with the air intake in the nose and the exhaust under the wing. It has been in large-scale production and squadron service for nearly three years, now has been allocated to the second line and for training. It is powered by a 4,000-lb. Chelomey axial-flow jet developed from the German Jumo 004. Armament consists of one 20-mm or 32-mm cannon plus two .5-in guns in the nose. Maximum speed is about 500 m.p.h., ceiling about 40,000 ft. and range approximately 400 miles.

Yakovlev YAK-17 is a single-seater single-jet straight-wing fighter somewhat reminiscent of the U.S. Republic F.84 "Thunderjet." The aircraft will shortly go into squadron service. Powered with a Rolls-Royce "Nene" or an engine developed from it by Chelomey, it is believed to have a top speed exceeding 620 m.p.h.

Yakovlev YAK-21, a rocket-powered single-seater fighter derived from the German Messerschmitt Me 163 rocket fighter, is now in squadron service for local air defence. The machine, a mid-wing design with high-set elevator unit, is reported to have flown at "far beyond" sonic speed.

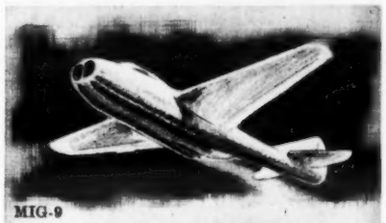
Lavochkin LA-15 is a twin-engined single-seater fighter. It has two axial-flow engines in wing nacelles.

Lavochkin swept-wing fighter : A new single-seater with sharply swept-back wings is going into limited service with the Soviet Air Force.

High-speed research aircraft : Two versions of a single-seater low-wing sonic research aircraft are being flown by the Soviet Air Force. One of the two has lateral air ducts, the other a nose air intake ; both have the exhaust nozzle in the tail. Power is supplied by a Chelomey axial-flow jet. Characteristic feature is the swept-back tailplane and elevator mounted on the top of the fin.

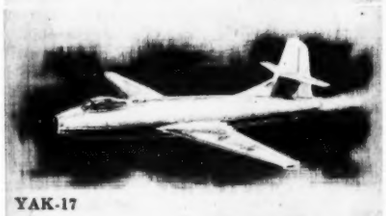
Tupolev : A twin-jet attack bomber derived from the Tupolev TU-2 piston-engined attack bomber is going into squadron service. The new type was first displayed at the 1947 Air Force Day show in Moscow. It is of mid-wing layout with a straight wing, twin rudder unit and a slight upward dihedral on the tailplane. The bombardier's station is in the transparent nose, and there are dorsal and belly gunner's positions aft of the wing trailing edge. The aircraft is said to be capable of about 450 m.p.h.

Ilyushin IL-16 : A bomber with a straight, high-set wing, the aircraft is powered by four Chelomey axial-flow jets mounted in individual pods under the wing. Crew consists of five men. Maximum speed is about 500 m.p.h. Bomb load is 5,000 lbs. and armament consists of cannon in a remote-controlled dorsal turret and in the tail turret.



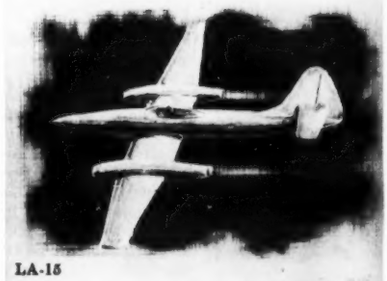
MIG-9

YAK-15



YAK-17

YAK-21



LA-15

Russian research aircraft

IL-16

Russia's Top Aeronautical Engineers

Tupolev

Lieutenant-General Andrei Nikolaevich Tupolev is the best-known and the doyen of Soviet aircraft designers. Together with Professor Nikolai E. Zhukovski he founded TsAGI, the Central Aerodynamics Research Institute. He has specialized in the design of heavy aircraft, notably the ANT-1, the ANT-3 which Gromov flew around Europe in 1926, the five-engined ANT-14 and the ANT-25 which Gromov flew from Moscow to the U.S.A. in 1937. In that year Tupolev disappeared from public view as a result of the 1937 purge trials and turned up again only after the Nazi attack on Russia in 1941.

He then designed four-engined bombers, including the TB-3 and TB-7 and, more recently, the TU-70 adaptation of the B-29. Altogether he has created about 25 aircraft types and has assisted other designers in their task, notably Ilyushin with the IL-4 torpedo bomber and the IL-16 four-jet bomber.

Ilyushin

Lieutenant-General Sergei A. Ilyushin was born in 1894 in Diviavili but left his village at the age of 15 and began to work in Leningrad. A few years later he was employed at an airfield outside Moscow and decided to become an aircraft engineer. After World War I he joined the Zhukovski Academy, from which he graduated in 1926. As a member of TsAGI he designed the IL-4 attack bomber. During World War II he created the famous series of "Stormovik" attack bombers, the IL-2, IL-3 and IL-10. He also has been responsible for Russia's standard transport aircraft, the twin-engined IL-12 and four-engined IL-18; his latest design is the IL-16 four-engined jet bomber.

Jakovlev

Colonel-General Alexander Sergeevich Yakovlev is the youngest and the highest-ranking of the well-known Russian aircraft designers. Now aged 43, he joined the Zhukovski Academy in 1926, where he designed his first aircraft, a lightplane. In 1936 he won first prize during the around-Russia flight with his UT-2 trainer. Since before the war he concentrated on the design of fighter aircraft, notably the YAK-1, YAK-3, the YAK-9, more recently the YAK-15, YAK-17 and YAK-21 jet fighters. He also was responsible for the creation of the new YAK-16 twin-engined feeder type.

Lavochkin

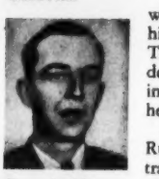
Lieutenant-General Semyon A. Lavochkin was born in Smolensk in 1900 and also has made fighter aircraft his speciality. Together with Gorbunov and Gudkov he designed the LAGG-1 fighter before the war. In 1940 there followed the LAGG-3 which performed very well against the Germans a year later. At the end of the war the LA-5 was one of the Soviet Air Force's standard fighters. The type has since been superseded by the LA-7 and the LA-11—the latter is one of the most modern piston-engine fighters in the world today and probably the last conventional fighter to be adopted by the Soviets. Lavochkin has since designed the LA-15 twin-jet fighter as well as a swept-wing single-jet of undisclosed designation.

Mikoyan

Major-General Artem I. Mikoyan is a Russian-Armenian and about 50 years of age. With *Mikhail I. Gurevich* he has long formed an outstandingly successful fighter design team which produced such types as the MIG-1, MIG-3 and MIG-5, as well as one of the Soviets' first and best standard jet fighters, the MIG-9. The two engineers have just completed an improved development of the type. It is reported that Mikoyan and Gurevich are now working independently, and that Gurevich has since completed a jet fighter of his own design.

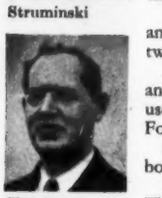
Gurevich

Vladimir Petlyakov was born in Rostov in 1891 and started his working life as a railway labourer. At the age of 31 he passed his examinations as a mechanical engineer and was admitted to TsAGI, where he became Tupolev's assistant. His best-known design is the PE-2 light bomber, large numbers of which are still in use with the Air Force. He also redesigned the Tupolev TB-8 heavy bomber, which in its new form was redesignated PE-8.


Struminski

Nikolai N. Polikarpov, who died in 1944, was one the earliest Russian fighter designers (I-15 "Rata," I-16). His PO-2 elementary trainer biplane is still in service with the Soviet Air Force.

Ivan P. Bratukhin is the Soviets' outstanding helicopter specialist and in post-war years has attracted attention chiefly by his "Omega" twin-rotor helicopter.

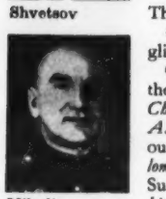

Shvetsov

Alexsi O. Shcherbakov engages notably in the design of gliders and also has produced a light transport, the ShchE-2, which is used as a communications aircraft by the Soviet and Polish Air Forces.

O. P. Sukhoy has designed a single-engined reconnaissance bomber, the SU-2.

Yermolaev is engaged in the development of medium bombers. The designation of his types is YER.

Oleg A. Antonov is the best-known Russian designer of cargo gliders.


Mikulin

Other prominent names in Soviet aeronautical engineering are those of *V. V. Struminski, G. Gribovski, V. B. Shavrov* and *B. I. Cheranovski*, aircraft designers; *B. N. Yuriev*, helicopter expert; *A. D. Shvetsov, A. A. Mikulin, Vladimir Y. Klimov, S. Isotov*, outstanding reciprocating engine experts; *N. Kostikov, B. Chelomey, B.S. Stechkin* and *A. M. Liulik*, gas-turbine engine designers. Successful aerodynamicists are *M. Volkov*, of TsAGI; *V.P. Vechinkin*, also of TsAGI; *P. P. Krashilovsky* and *S. A. Kristianovich*.

Research and Development

In the last three years, the Soviets have introduced profound changes also in their aeronautical research and development methods. Whereas before and even after the war Soviet research was concentrated on a limited number of simple and cheap engines, aircraft and equipment, development work has been extended over a vast number of fields and a vast number of individual projects, in an obvious effort to keep up with developments abroad. As part of the same plan, a significant change has been made in the set-up of Soviet aeronautical research: until a few years ago, this research was concentrated in two or three aeronautical engineering institutes, such as the TsAGI research establishment, the Zhukovski Aeronautical Engineering Academy in Moscow, the TsIAM aero-engine and the VIAM materials institutes. At present, nearly every aircraft and engine factory has its own design and development office. This is indicative of the important fact that Soviet engineers have mastered the basis of post-war aeronautical engineering and are preparing to put their own ideas into operation.

This does not mean that centralized aeronautical research is being neglected. In addition to the establishments listed above, the Soviet Government has just completed a new installation for TsAGI outside the capital; another new experimental institute has been built at Kuchino, 25 miles from Moscow; the Air Force Scientific Experimental Establishment at Chkalovskaya, outside Moscow, is working at full blast; so are the aviation research institutes at Novosibirsk, Voronezh and Kharkov. Here again, the Russians profited extensively from their war-time conquests: their booty included the entire installation of the Central German Aeronautical Research Institute ("Deutsche Versuchsanstalt für Luftfahrt") at Berlin-Adlershof and the substantial ruins of the Peenemünde experimental rocket station.

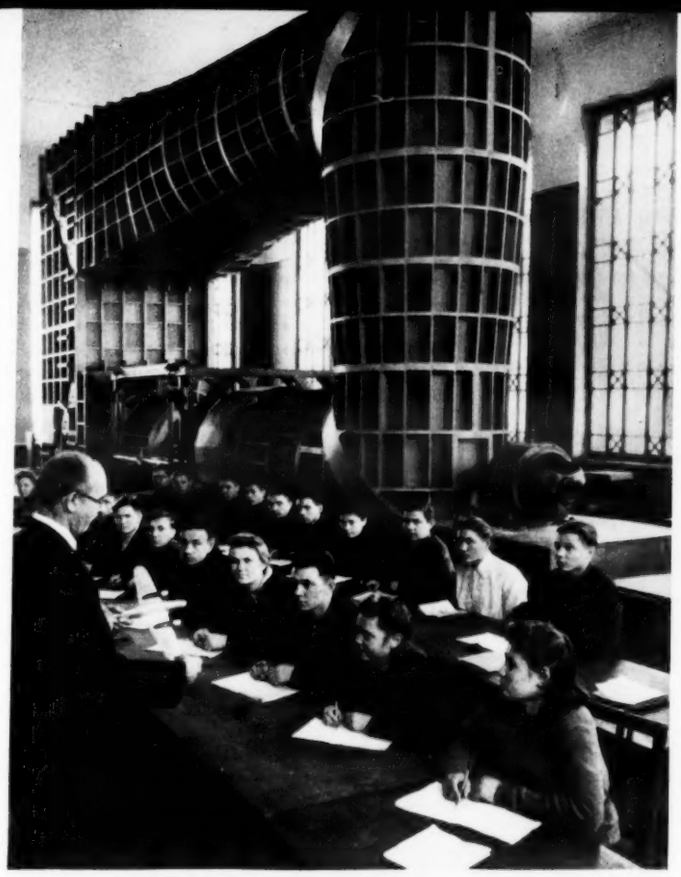
Rockets and Guided Missiles, too

The Soviets' occupation of the Peenemünde rocket centre is not—as is widely believed—the principal reason for their rapid progress in the domain of rocket propulsion. First of all, Peenemünde was bombed to smithereens before the Russians even found it, and they have now only just completed its reconstruction. Secondly and more important—while the Soviets certainly have encountered difficulties in the development of gas-turbine engines, they have always been far advanced in the field of liquid and solid-fuel rockets, as is evidenced by Captain Bakhchivanski's flight in a primitive rocket-powered aircraft in 1934. Russian work on rocket propulsion, started long before the war, never stopped despite a pointed lack of encouragement from the top. But even this limited work, conducted notably by Professor Kostikov, paid off early in World War II with the production of the "Katyusha" anti-tank projectile. It is obvious, too, that all the weird and wonderful forms of rocket-shaped German "hate" which fell into the hands of the Soviet Army were a welcome addition to the Soviet rocket arsenal, and in any future war the Russians may be counted on to fire every kind of German-designed rocket that was found operationally practical.

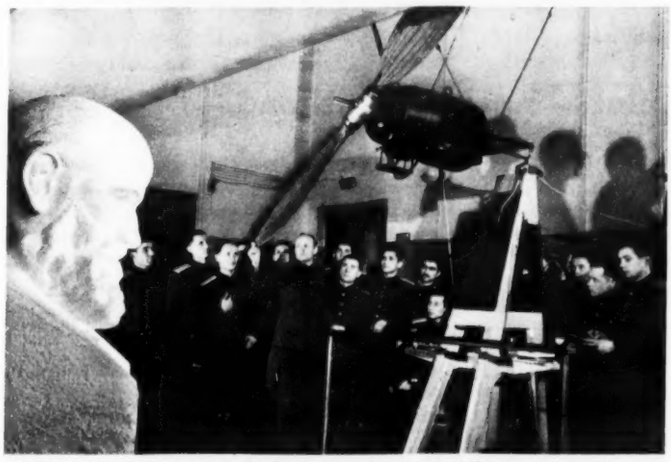
Several well-known names are today connected with Russian rocket research, including—in addition to Kostikov—such scientists as Constantin Tsyolkovsky, Rynin, Petrovich and Shershevski.

Quite evidently this research has produced tangible results. Peenemünde, as just stated, has been rebuilt completely and again is in operation as an experimental and testing station. The place has been completely cordoned off and surrounded with high-voltage wire fences. Its major concern at the present time is reported to be the development of a "transoceanic" guided missile (possibly the A.9 two-step rocket, work on which was started by the Germans), as well as the production and testing of anti-aircraft rockets such as the Rheinmetall-Borsig F-25 or F-55 "Feuerlilie" of 1941-1945. Peenemünde's own production effort is supplemented by the output of a specialized factory at Rechlin, in the North-East of Germany.

Judging by reports reaching the Western part of Germany, the Russians have taken over where the Germans left off as regards the actual operation of guided missiles. Although it is not possible to obtain a definite confirmation of these reports, it nevertheless seems an established fact that as part of their defensive system the Soviets are building a network of guided-missile firing ramps aimed at Western Europe. Eleven firing sites, comprising five single-battery and six triple-battery stations, reportedly have been completed. Single-



Students in the third grade in their aerodynamics laboratory.



Air Force Officer-students at the Zhukovsky Aeronautical Engineering Academy in Moscow.

"Catch 'em young" : At the Leningrad "House of Pioneers," head-quarters of the para-military youth organizations. Boys and a girl at the small-scale wind tunnel.

battery sites are located in Mecklenburg in the vicinity of Neustrelitz and between Anklam and Wolgast, to cover Southern Sweden ; in Thuringia, south of Erfurt, covering the industrial area of Dusseldorf and Cologne and the Waal-Schelde area ; at Guben, to close the Baltic between Malmö and Rügen Island ; near Pilsen, in Czechoslovakia, to cover the Brenner Pass. Groups of three triple-battery posts each are reported in the vicinity of Hradec-Kralove, in Czechoslovakia, and in a semi-circle 20 miles west of Stettin, Poland. The former of the two groups is intended to cover part of the Balkans and the Adriatic Coast, the latter the coast line from the Low Countries to the Bight of Heligoland.

*

This, then, is as accurate an outline of Soviet air strength as it is possible to draw from available, incomplete data. It shows that the Russian Air Force is numerically strong, of good operational and technological quality—and improving. It discloses, furthermore, that the Russians are adapting their air force to the modern concept of global air strategy, without neglecting the tactical roles of the air arm. And it underlines the fact that the Russian aircraft industry is capable, vigorous and prepared to carry out pioneering work in such unorthodox fields as rocket propulsion and guided missile development.

Questions of major interest are the following, however : Why did the Soviet Government start an armament race even before the smoke of World War II had time to disperse ? What do the Russians propose to do with their air power ? Will they, as General Kenney forecast, start "Operation America" as soon as they feel that they can win a conflict ?

To find an answer to these questions, it is necessary to digress from the subject of aviation, since the policy which would send this air force into action is the determining factor. The truth simply is that the masters of the Soviet Union continue to believe, with characteristic rigidity, in the Marxist dogma of the inevitability of the collapse of the Capitalist-Bourgeois order of things. This same theory also predicts an "Imperialistic war" as the final upheaval prior to the death of the old order, and it is against this dogmatic "certainty" that the Soviets are preparing their armed forces. As incredible as it may sound, the key to their rearmament effort is just one thing : fear. Proof of this is the fact that it has never been in Russia's tradition to start a large-scale aggressive war which would have involved her in an all-out conflict with the big powers. Her aggression of Finland in 1939, her pre-1941 violation of the Baltic countries, Poland and Rumania, her post-war "alignment" of Czechoslovakia, Poland and the Balkan countries never produced such a risk. It is proved also by Russia's military preparations : her air force is still mainly a defensive weapon, although it includes a large potentially offensive element ; her efforts in the guided missile field are also concentrated on defensive measures and designed to make possible the bombardment of the potential areas of deployment of the Western powers along the North Sea and the Mediterranean : there are no guided-missile ramps pointing to the centre of the Western European land mass.

Air Marshal Vershinin, Commander of the Soviet Air Force, confirmed this view by a statement he made in an interview in September, 1947 : "In order to assist Communism to win final victory, we shall fly farther, higher and faster than all the others." Now, any national air force worth its salt claims to be capable of flying farther, higher and faster than all the others. The operating word is "final victory." Communism is a religion : in countries where it is not the official creed you don't spread it in the grand Charlemagne manner of chopping off your potential disciples' heads. Communism spreads on its own, like yeast. It is only to wipe out the last vestiges of resistance to Communism in the world that the Soviet Air Force, together with such other components of the Russian armed forces as are necessary, will go into action to bring about the "final victory." Therefore, as long as the Western World succeeds in refuting the Marx-Engels dogma of the inevitable demise of Bourgeois society by producing an order appealing to the large masses of the people, the Soviet Air Force will remain on the defensive.

Esmeralda's dazzling indignation

Sir,

Recently I met your charming Esmeralda at the A-class bar of an ICAO A- or B-class airport. However, the purpose of my writing to you is not to enlarge upon her enchanting feminine qualities. The fact is that your favourite air hostess favoured me with a few revelations that were distinctly spine-chilling, and I think you ought to hear about them.

As you already know, Esmeralda, like all her colleagues, is keenly interested in most of the general aspects of aviation. Well, this interest recently focussed itself on to landings in bad visibility—all that stuff about heroic pilots valiantly battling with the underlying limbo to bring big airliners safely down through the fog and gently on the runway, had strained Esmeralda's curiosity to breaking point. With the coming of the first September mists, therefore, she began slipping into the cockpit before each landing, just after she had added her vocal entreaties to the luminous "Fasten Seat Belts" sign.

By the way, I got a distinct impression that she likes the pilot quite a lot—at least, as much as her devotion to Interavia*'s editor permits ; but that is beside the point. At the time we are talking about, Esmeralda's emotions were gripped by the landing procedures : the radio approach, then the appearance of the approach lights, and finally the runway illumination. The first time she witnessed this, she nodded her approval. But after watching it at Schiphol, Le Bourget, Heathrow, Shannon, Gander, Idlewild, and what have you, she was horrified : there weren't two lighting systems alike !*

The pilot, to whom she confessed her horrified surprise, patiently expounded for her benefit a learned treatise on Westinghouse, Slope Line, Calvert, Bartow, and other lighting systems. But her faculties remained muddled by the crazy confusions of lights which came up suddenly and unsystematically through the fog.

Naturally, she asked me why lighting systems couldn't be installed in the same pattern at all airports. At a loss for a better answer, I told her she ought to know, from her associations with Geneva, that the simplest problems take on mammoth proportions when different governments have to solve them to mutual satisfaction.

It was at this point that your charming Esmeralda shook me to the core. With a dangerous gleam in her eye she replied that, the next time prior to a landing in really bad visibility, she would announce to the passengers : "We're arriving at X, it's QBI (Q-code for instrument landing weather), and you have five minutes to say your last prayers."

The going was uphill, but I finally managed to convince her that there was no need to carry matters that far—that she would almost certainly lose her job, and consequently fall into disgrace as far as Interavia *was concernad. Anyhow, she said she would conceal her thoughts, but nevertheless remain true to them inwardly, by announcing on the next occasion : "We're arriving at X. Would anybody like a last drink ?"*

Frankly, this letter from our reader, bearer of Esmeralda's indignation, puts us on the spot. Of course, we could say that ICAO's AGA Division (Aerodromes, Air Routes and Ground Aids)—composed of AGA-ish experts from all the airfaring countries—met in Montreal on November 1st precisely to agree on a standardized pattern for lighting systems—so why worry ?

But we all know international organizations—even our dearly beloved International Civil Aviation Organization. Their conferences do not invariably end with the neatly parcelled solutions envisaged by everybody outside the conference room. Such meetings are the scenes of clashes between frankness and prejudice, farsightedness and narrow-mindedness, generosity and vanity . . . briefly, all the virtues and vices of mankind and nations. No one can ever prophesy the exact outcome. In the present case of airport lighting, many governments and airport administrations have already —either hastily or because conditions gave them no alternative—sunk lots of money into what are perhaps unsatisfactory systems, whilst others are awaiting the results of the conference and are making out with stop-gap equipment. Nor should we forget those who have spent a lot of money on exhaustive experiments, in order to be able to bring proven suggestions to Montreal.

Thus, we cannot promise that the AGA Conference will pour balm into Esmeralda's wounds. We can only hope one thing : that all participants realise the danger threatened by the present confusion and how urgent the need is for a rapid passage to standardization.

Galland — Germany's ace pilot — now lives abroad

The following biographical sketch of the former Luftwaffe's Inspector of Fighters, Adolf Galland, is taken from letters received from one-time Luftwaffe officers. — Ed.

Rumours which have recently circulated about ex-Luftwaffe General Galland appear to be true : He is now in Argentina, where he is alleged to be co-operating in some way with the German aircraft engineer, Professor Tank, well-known as the designer of the Focke-Wulf F.W. 190 fighter.

Galland, lastly Inspector of the Luftwaffe Fighter Forces and bearer of a whole string of German medals, pursued an exciting carreer in two ways during the last war : During the first two years of the war he was—in competition with his rival, Mölders—right at the top of the Luftwaffe ladder as regards victories in the air. Later, as a General, he was the Luftwaffe's most powerful and most feared officer.

This tight-lipped, ambitious man had already attracted public attention during the Spanish Civil War. As the commander of a dive-bomber group he revealed a degree of ruthlessness and skill which won him Hitler's Spanish Cross with Diamonds.

Galland entered World War II as a fighter group commander. Then the struggle began between him and Colonel Mölders. Both were mentioned again and again in reports, but Mölders was the first to achieve his hundredth victory in the air. It was around this time that Mölders was withdrawn from the front line and appointed Inspector of the Luftwaffe Fighter Forces. But his career came to an abrupt end : in November, 1941, he crashed—this is true for once—while flying through a snowstorm on his way back to Berlin from the Crimea. And Galland took over his position.

That marked the beginning of the second and decisive part of Galland's career. He pursued his plans with unimaginable energy. As early as 1941 he evolved the idea of developing the Luftwaffe's fighter forces so as to provide a roof over Hitler's mythical "Fortress Europe"—seeing in this the only way of meeting the growing threat of the Anglo-American bomber forces. Ruthlessly, and with unshakeable precision, he had prophesied the Allied onslaught at a time when Germany's air power was universally considered to be invincible. Thirty years old, he became Germany's youngest General in 1942 ; but his warnings went unheeded.

It was likewise at this time that the Germans developed the Messerschmitt Me 262, the first utilisable jet aircraft and undoubtedly the fastest fighter then in existence. Galland's hopes were pinned to this aircraft. However, his "leader"—in his frenzied desire for vengeance— was not of the same opinion. Completely ignorant of the true air situation, Hitler personally ordered that the Me 262 be converted into a bomber. This was shortly followed by a serious dispute between Goering and Galland. Ripping off all his medals, except the Spanish Cross, Galland retreated into the background. By the summer of 1944, however, he succeeded in making Hitler change his mind as regards the Me 262. But it was too late. The last act of the German tragedy was already drawing near the end. Goering had to find a scapegoat on whom to blame the collapse of his Luftwaffe, and Galland was conveniently placed for this sacrifice. His job was given to General Gollob, who was certainly not up to the task. He delivered a strong attack against Galland, which ended with the latter before a court martial. The fact that Hitler quashed the trial and that Galland, at his own request, returned to the front line as commander of a fighter group, is beside the point. The once powerful man was now powerless.

Galland and Goering in 1944 : Worried faces.

Politically, his attitude was always vague. It is certain that he did not belong to the group which tried to bring about Hitler's downfall on July 20th, 1944. His plans probably gave him no time for politics. He was a typidal product of his environment—by necessity, a Nazi General.

At present he is in South America, and little is heard about him. But those who knew him, who worked under his orders, do not think that such a man can simply sink into oblivion. A lot of fuss has been made about smaller men, and there is no reason to disbelieve that cold, ruthless Galland—methodical, clever and hard as he is—may not arise again as a General of the Argentine Air Force.

Democracy in an Aircraft Firm

Presidential Election — or Boxing Bout — at FAIRCHILD ENGINE AND AIRPLANE CORPORATION

At a general meeting about four months ago the shareholders of the Fairchild Engine & Airplane Corporation, one of the larger U.S. aircraft and engine manufacturing concerns, kicked out their Board of Directors and installed a new management. Now, management changes take place periodically in almost any firm—but it is usually the Board of Directors who fire the President (who then announces his resignation because of ill-health) or a Vice-President or a Manager. You don't often see the Board itself getting the sack, even though stockholders have it in their power to do so.

The Fairchild management fight had all the ingredients of a U.S. Presidential election campaign. The Chairman and his Board—in politics they would have been the President and his administration—had every wish to stay in office. Disregarding this very natural desire, the opposition worked out a new slate of directors, the voters—stockholders in this case—went to the ballots and the old Board went over itself, *i.e.,* overboard.

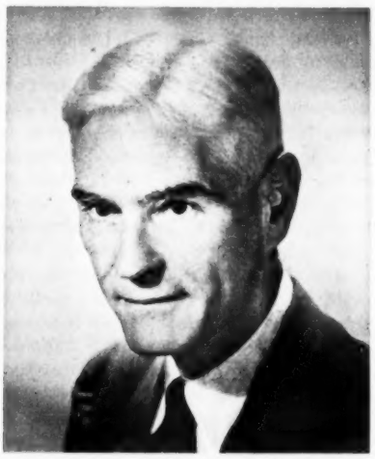
The change in the Fairchild management was preceded by a fierce election campaign and hardly restrained invective—the latter carefully but thinly veiled to keep it inside the libel and slander laws. Just like Republicans and Democrats in the U.S.A., Conservatives and Labourites in the United Kingdom, each party accused the other of inefficiency, cowardice and selfishness.

Sherman Fairchild Enters the Ring

Discontent with the management of Fairchild had been smouldering for a long time. Notwithstanding the fact that, unlike most other U.S. aircraft firms, the corporation had made a profit every year since 1939, stockholders were uneasy because since the war Fairchild has concentrated its whole energy on military business at the expense of its pre-war activity in the civil aircraft and engine field. However, this latent dissatisfaction did not provide the leaders of the anti-management faction with a tool to take effective action.

This tool was obligingly furnished by the management itself. Some time ago the Fairchild Board of Directors voted a plan to provide ample security for the years of retirement of J. Carlton Ward, Jr., Chairman of Fairchild. Originally, Ward's employment contract called for a $50,000 salary a year, plus four percent of the net profit above a certain level (in 1948, for example, Ward drew a total of $118,000), plus a single $25,000 payment upon Ward's retirement from active management. Ward considered this as insufficient, and the new plan approved by his directors stipulated that he was to receive $32,500 a year for life upon his retirement (this was reduced to $25,000 a year in December, 1948). The arrangement in principle also extended Ward's employment to December 31st, 1957; but, chief of all, it more or less gave him a free hand to decide when he actually wanted to retire—in the case of mental or physical ill-health, or *if he found that he could not work harmoniously with a new management!* Alternatively, in the event of his demise, Ward's wife was to be paid substantial sums of money.

"Shatterhand Sherman": Sherman M. Fairchild, winner of the Fairchild *vs.* Management bout. Founder of the Fairchild Engine & Airplane Corp., he holds no executive office in the company.



"Battling Board": J. Carlton Ward, ex-Chairman of the Fairchild Board, who lost the battle against Sherman M. Fairchild. His retirement contract, one of his enemy's principal arguments, was not the real issue of the dispute.

This contract was a godsend to Sherman M. Fairchild, founder and erstwhile President and Chairman of the company. Early last April he started a whirlwind campaign to prevent the Ward management from being re-elected on April 27th, 1949, date of the annual General Meeting. He promptly climbed over the ropes and proceeded to "give 'em hell," as Harry S. Truman promised to do during his election fight. The difference between the two campaigns was that Fairchild's battle ended up looking like a boxing match more than anything else.

Sherman Fairchild was the obvious leader of the stockholders' revolt. He is the largest single stockholder, though he owns only about 4.14 percent, or 95,679 shares, of the 2,308,817 shares issued to 10,245 stockholders. But he had founded and headed the company and only left it in October, 1946, after attempting unsuccessfully to have the firm become more active in civil aviation manufacturing.

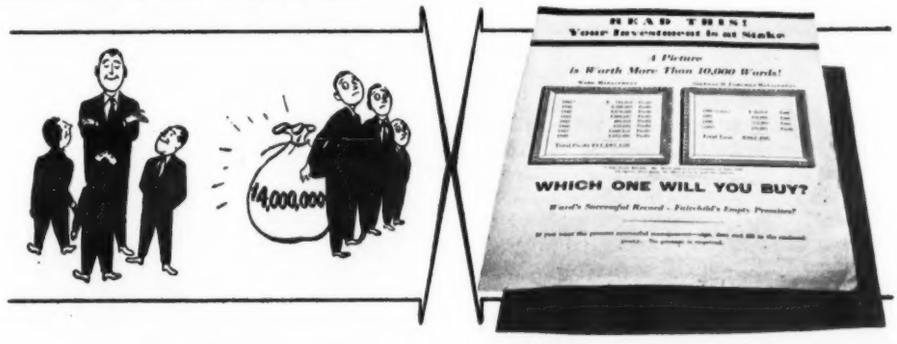
The First Round

The ring is ready, the bout starts—just a few days before the original date set for the General Meeting. Sherman Fairchild wants to gain time to establish his own slate of directors, in other words, a rival management. For this purpose, he must prevent the re-election of the Ward management. The only way to do this is to organize a "stay-away strike" among stockholders in order to deny the assembly the power of decision by preventing a quorum of shareholders from being present.

The management in office evidently wants such a quorum established. Each party ties itself into knots to get the precious proxies—*i.e.,* authorizations by stockholders to cast the votes in their names. Large quantities of statements, announcements, pamphlets and handbills, paid-reply postcards and "open letters" are inflicted upon the hapless stockholders. There has never been a pugilistic exhibition unaccompanied by propaganda.

Sherman Fairchild, alias "Shatterhand Sherman," opens the battle with a right-hand swing which lands in the opponent's solar plexus. He accuses the management of not disclosing to stockholders the retirement

From "Shatterhand Sherman's" campaign literature. Left: "The subservience of the Ward Group of Directors..." — *Right:* "The failure of the Ward group to disclose post-war losses" of certain operating divisions...



From the "Battling Board's" campaign literature.

arrangement concluded with J. Carlton Ward, Chairman of the Board, which he calls a "wholly indefensible waste of corporate funds." The Ward management, also known as the "Battling Board," retaliates weakly by proclaiming that "the letter, pamphlet and return postcard sent to stockholders by a former dissatisfied officer of the corporation should not mislead anyone." The Ward decision, it claims, belongs to the "proper functions" of a Board of Directors. Fairchild counters by stating that the decision of large-scale "life-or-wife" payments lies with the stockholders. Anyway, Ward's retirement benefits should not be so "special" as not to be capable of incorporation in the general pension plan under consideration.

April 27th, 1949, original date of the General Meeting : the Ward management sends out a letter stating that the General Meeting has been adjourned until May 11th. The Battling Board in effect admits that it has lost the first Battle of the Quorum. The opening round goes to Shatterhand Sherman. But the Board hasn't hit the boards yet : in an oracular voice it announces : "Sherman M. Fairchild has finally shown his hand ! He has made it clear that he wants to regain control of the corporation . . ."

The Second Round

Just like a boxing match—or a presidential election—the opening round has started to make tempers rise. Time is short—just two weeks until the next General Meeting. Slugging begins in earnest—each group tries to show what scoundrels the others are. Shatterhand Sherman again leads the attack. "Neither Mr. Ward or his Admiring Directors," he writes, "any longer deny that he was given $13,300 of corporate funds with which to 'repay' his debt to the company, although they hid this gift until we smoked them out." And so on, eight more paragraphs beginning, "Neither Mr. Ward nor his Admiring Directors . . ."

The Battling Board does not remain inactive either. It attempts to wear the adversary out by soliciting proxies on a grand scale. It intimates that Sherman Fairchild is so unpopular that he cannot even establish his own slate of Directors. And it claims that this period of unsettlement is detrimental to the interests of the corporation and should be kept as short as possible.

May 11th, 1949, date of the adjourned meeting. Again, no quorum is available. The stay-away strike is still on. Second round to Shatterhand Sherman !

The Third Round

The Battling Board rushes out of its corner with a swing to the head in the form of another letter to the stockholders, dated May 23rd. "Despite Mr. Sherman Fairchild's efforts to get stockholders to revoke or withhold their proxies, more than 80 percent of the shares required for a quorum on May 11th were represented by proxies in favour of the management... As requested by Mr. Fairchild, the new date for the meeting is July 6th, 1949..." This time Sherman Fairchild obviously has asked for ample time—eight weeks—to prepare for the final show-down.

Richard Schley Boutelle, Fairchild Vice-President, General Manager of the Aircraft Division, outstanding aircraft production expert, sided with Sherman Fairchild early in the dispute. He was sacked, now is President of the company.

Admiral Lawrence Baxter Richardson, wartime naval commander, subsequently Curtiss-Wright Vice-President, lately Fairchild President. It was he who directed "operations" against Sherman M. Fairchild ; he has now left the company.

James Ashton Allis, former Member and new Chairman of the Board of Fairchild's. A financial expert, he is a Vice-President of the Grace National Bank.

Blows now begin to fall fast and furious. Shatterhand Sherman comes back with a left hook on June 1st and announces a slate of Directors to oppose the Ward Board, refuting the latter's insinuation that he was unable to raise sufficient support among stockholders. Included in the list, as an extra punch, is the name of Grover Loening, pioneer aircraft constructor, first President of the Aeronautical Chamber of Commerce of America, Consultant to the National Advisory Committee for Aeronautics on private aircraft design ; Loening is a strong civil aviation advocate and known for his conviction that the manufacture of private aircraft in the U.S.A. can become important commercially if new and revolutionary aircraft types are introduced. The corporation's failure to produce post-war civil aircraft was, as indicated, one of the major issues in the dispute.

Shatterhand Sherman follows up with a right uppercut by announcing that Richard Schley Boutelle, one of the corporation's Vice-Presidents and a Director, General Manager of the Hagerstown Fairchild Aircraft Division, the corporation's major plant, is now also backing Sherman Fairchild's fight against the Ward Management. At the same time, Arthur F. Flood, Comptroller of the Corporation, makes a similar announcement. Both are immediately added to the Sherman Fairchild slate.

The Battling Board promptly goes into a clinch by issuing a statement June 6th to the effect that it had sacked both Boutelle and Flood. It breaks away on June 16th and comes back with a swing to Shatterhand Sherman's chin with the declaration that the Chairman's retirement plan has been cancelled at Mr. Ward's own insistence. Old Shatterhand mildly observes that this "masterstroke" is a phoney action designed only to calm down stockholders who would have been milked by the Ward retirement plan. The Battling Board also published a table of statistics showing that out of thirteen major U.S. aircraft manufacturing concerns only *two* consistently operated in the black in the post-war period : Fairchild was one of the two.

Shatterhand Sherman, nevertheless a little surprised at this development, merely attacks the Battling Board with two pages of light banter dated June 18th. "What has happened to the 'indispensable' Mr. Ward ?," he asks. "Has he become interested in stockholders, or is he just plain afraid of what will happen on July 6th when our proxies are voted ?" Quickly he rallies, however, and delivers a smashing body-blow on June 21st : he releases a list of twenty top executives of the Fairchild Aircraft Division protesting against the dismissal of Boutelle and Flood, who "were primarily responsible for the success of the Division..."

Third round to Shatterhand Sherman, on points.

The Fourth Round

The Battling Board and Shatterhand Sherman dance around each other, looking for a weakness in the opponent's defences. The Battling Board opens the round with two loquacious statements, dated June 23rd and 25th. The first reiterates that Shatterhand's *real* intention is to re-acquire control of the

One of Fairchild's principal products : the C-119 "Packet" military transport, successor to the C-82 "Packet." Fairchild has pioneered in the specialized military transport field, is engaged in many other military activities.

The "Helioplane": Fairchild President Richardson on June 26th announced that the company had acquired manufacturing rights to this fast-flying, slow-landing, stall-proof, spin-proof personal aircraft. While the design is interesting, it was bought chiefly to take the wind out of Sherman Fairchild's sails.

corporation, the second seeks to show that Sherman's proposed Board of Directors is entirely unsuited for its task. The latter is the answer to a release issued the same day by Shatterhand's seconds, his Committee of Stockholders, which endeavours to prove that the Board in office is totally subservient to Mr. Ward, that not enough profits are paid out in dividends, and that Mr. Sherman Fairchild will refuse to accept any executive position in the company even if his slate of Directors is accepted.

The Battling Board is undeterred, however, and maintains its attack. It pitches smack into Shatterhand Sherman on June 26th with the important announcement that it has made arrangements for the manufacture and sale of the revolutionary "Helioplane" light aircraft, designed by Otto G. Koppen, Professor of Aeronautical Engineering at Massachusetts Institute of Technology, from specifications drawn up by Dr. Lynn L. Bollinger, Professor at Harvard Graduate Scholl of Business Administration. The move is obviously intended to invalidate one of the principal reasons for the whole row : the fact that Fairchild Engine and Airplane Corporation has not engaged in civil aircraft manufacture since the end of the war.

The plant of the Fairchild Aircraft Division at Hagerstown, Md.

The round then proceeds on a note of caution, with the opponents trying to make out, on the one hand, that Shatterhand Sherman's management in the late 'thirties had produced nothing but losses, and, on the other hand, that the Ward management could have made much more money if it had guided the corporation's activities in other directions. Furthermore, Ward accuses Boutelle and Flood of having deserted to the enemy because they were "motivated by the possibility of personal gain." In reply to which Shatterhand Sherman punches Battling Board on the nose by asking : "Let's finish this... just what motivates YOU, Mr. Ward, beside personal gain ?"

The Final Count

The referees of the contest, the stockholders, meet on July 6th to decide who has won the bout. It is a long meeting, the atmosphere is tense, and it is only on the night of July 8th that the results become known. The scene now changes back to that of a presidential election : a majority of stockholders have been convinced that Sherman Fairchild was right, and when the Ward management finally conceded defeat, Sherman Fairchild's slate was running ahead nearly two to one. The final count showed that of a total of 2,308,817 voting shares, representing over 10,000 stockholders, 1,813,403 were cast to decide the issue. Shatterhand Sherman's slate received a total of 1,191,217, the former management 622,185 votes. Sherman Fairchild therefore reached more votes than the figure necessary to constitute a quorum in his own right, 1,154,409 shares. Richard Schley Boutelle was elected President of Fairchild Engine & Airplane Corp., Sherman Fairchild, a member of the Board ; James A. Allis, Vice-President of the Grace National Bank and member of the old Board, became Chairman.

Like in any election in the U.S.A., the defeated candidate departed graciously. J. Carlton Ward, ex-Chairman, said on behalf of the outgoing management that he "sincerely hoped that, in the national interest, Fairchild's new Board will be successful in carrying forward the many major products in research and production that have been entrusted to the corporation by the military services."

Democracy in an aircraft firm ? Surely ! Fairchild's unique management battle shows that far from being "oppressed" by "big business"—as we are insistently being told by the funny long-haired men who rarely shave, never wash—the small man in the street (the interests owned by Fairchild's average shareholders are very small) can play an important role in his business if he has the energy to go out and take an active part in the proceedings.

Gobs in the Med

The Romans' "mare nostrum," the Mediterranean Sea, which later became a British lake ; subsequently was temporarily restored to its former position by Mussolini ; only to be turned into the Axis' "nightmare nostrum" and an Anglo-American lake towards the end of the last war, now has become the American "Med." America's Two-Ocean Navy continues to maintain a special Mediterranean Fleet, complete with aircraft carriers, which acts as the watchdog over the U.S.A.'s vital petroleum interests in the Near East and generally keeps an eye on Soviet-sponsored developments in the eastern part of the Sea.

The Mediterranean Fleet also functions as the U.S.A.'s roving ambassador whenever the occasion arises. So it was reported in the second half of September, for example, that Admiral L. R. Connolly, Commander of the U.S. Forces in the Mediterranean, had paid an official visit to El Ferrol, Spain's principal naval arsenal, where he met General Franco. Franco, who still is "blacklisted" by the Western Powers, reportedly offered to place a Spanish naval base at the disposal of the U.S. Navy "any time it wished." Even though the U.S. would no doubt have to pay for the privilege by making Marshall Plan dollars available to the Spaniards and by getting the Caudillo out of the State Department's doghouse, the offer represents a handsome

En route : Breaking up the monotony of a long stretch at sea, personnel aboard the "Philippine Sea" take part in a sack race on the flight deck.

France : Crew members buy perfume for their girls from a French dealer while docked at a port in southern France. The men are Al Fisher of Chicago, and W. F. McGowan of Springfield, Mass. The pretty demoiselle is Annette Astraud of Grasse, the French perfume industry centre.

U. S. S. "Philippine Sea" in Sicily : Italian visitors inspect the carrier's flight deck at Messina, Sicily. The aircraft are Grumman F8F "Bearcat" single-seater fighters.

Italy : The Gobs get a bird's eye view of an Italian port from the flight deck.

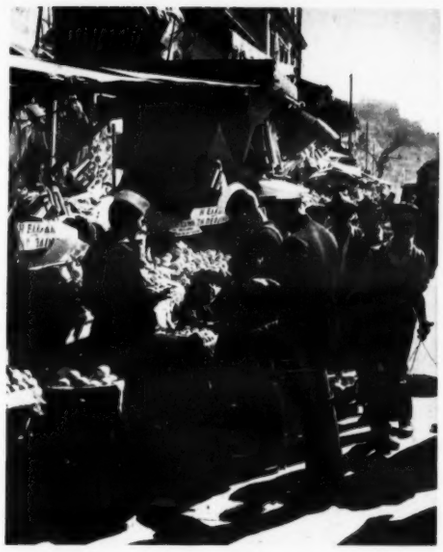
Athens : If you go to Athens, you've got to see the Acropolis... Members of the U.S. Marine Corps, Navy and Air Force, together with Greek sailors and Royal Guards (Evzones), inspect the ancient ruins. The guide might be encountered in Paris, Rome, anywhere...

Distinguished Guests : King Paul and Queen Fredericka of Greece come aboard the "Philippine Sea" as guests of Vice-Admiral Forrest P. Sherman, then Commander of the Navy's Sixth Task Fleet.

Greece, whose anti-Communist struggle is heavily backed by the U.S.A., received the "Philippine Sea's" longest visit. Left to right: W.A.J. Dalton of New Bedford, Mass.; N.D. Bell of Jacksonville, Fla.; and J.B. Goery of Galeton, Pa., buy fruit in Athens. The packing differs from that of fruit grown in California and Florida...

Malta : The "Philippine Sea" leaves Grand Harbour, Malta, at the end of its tour of the European ports along the Mediterranean.

Homeward-bound : Silhouetted in the sun, the 45,000-ton carrier "Philippine Sea" leaves for home after its goodwill tour.



diplomatic result for a grizzled sailor. Anyway, Admiral Connolly is reported to have said thank you, not at the moment, but we wouldn't mind having Cartagena and Palma de Mallorca in the event of war...

The role of naval ambassador is not confined to people with yards of braid on their sleeves and scrambled eggs on their hats. The U.S. Navy periodically sends one of its representative vessels on goodwill tours through the Mediterranean, and every "Gob"—the American equivalent for the British "tar"—who gets ashore acts as a special envoy. Americans are pleasant fellows generally, sailors have always fired the imagination of the local landlubber and, last but not least, American sailors always have a dollar or two to spend on shore leave. Here are some pictures of the goodwill tour made last summer by the 45,000-ton fleet carrier "Philippine Sea" of the U.S. Navy's Sixth Task Fleet.

A Short "Modified S 27" is flown up the Thames on August 10th, 1912.

The British Aircraft Industry

(PART VI) BY C. G. GREY, LONDON

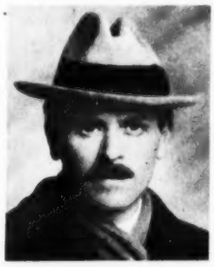
Short Brothers Ltd.

After dealing, faithfully I hope, with the biggest combinations of aircraft firms in the British Aircraft Industry, I think that the fairest thing to do is to deal with the oldest firm, and that, I am fairly sure, is Short Brothers Ltd., officially of Rochester, but for big production linked with Short & Harland, Ltd., of Belfast, the capital of Ulster, which is the proper name of what is commonly called Northern Ireland.

For some years before even the Wright Brothers flew, two of the Short Brothers, Eustace and Oswald, were the official balloon-makers to the Aero Club (not yet Royal) of Great Britain. One of the many fervent balloonists of the Club was Griffith Brewer, a well-established patent agent in London, and he was very friendly with the Shorts.

When he had reliable evidence from the U.S.A. that the Wrights had flown he went to the States, made friends with the Wrights (nobody could resist being friends with Griffith Brewer), and came back as the accredited Patent Agent for the Wrights and with their sales and constructional agency in his pocket to give to a worthy firm. So naturally he took it to his friends the Short Brothers, who at that time were making their balloons under the railway arches at Battersea Park, in South East London.

Horace Short, the great engineer, in 1909 started to design aeroplanes under Wright licences. He died during World War I.



Eustace Short, the artist, preferred the placidity of balloons to aeroplanes. He took little active interest in aircraft construction, but died in the cockpit before World War II.

Oswald Short, the "kid brother," who took charge after the death of brother Horace. He now is the company's Honorary President for life.

The proposal to build aeroplanes, before anybody had flown in England, or indeed in Europe, brought down from Newcastle-on-Tyne Horace Short, the eldest brother, a great engineer, who had worked with the Honourable Charles Parsons (the son of Lord Rosse, of the famous telescope) in the design and construction of the first steam turbines. Horace had participated in the building of the little turbine boat "Turbinia," which had shocked and surprised the navies of all nations by appearing unasked and unannounced at Queen Victoria's last Jubilee Review at Spithead in 1897 and catching and passing and running away from the British Navy's crack destroyer, between the anchored lines of great warships. He had many other engineering feats to his credit.

E. D. A. Herbert, O. B. E., Chairman of Short Brothers & Harland Ltd.

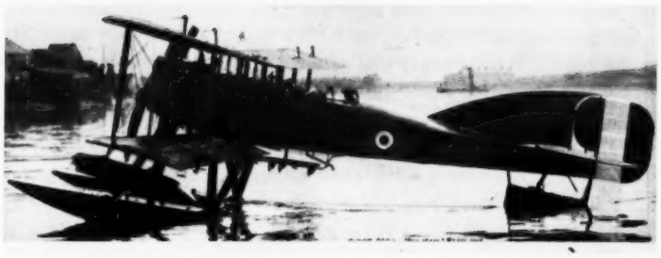
Rear-Admiral M. S. Slattery, C. B., R. N. (Ret.), Managing Director of Short Bros. & Harland, Ltd.

Such was the man who appeared suddenly and founded the first British aircraft firm.—Mark you, it was a partnership of brothers and not a limited company till some time later. Brother Eustace was an artist by trade and was not much interested in aeroplanes for they lacked the placidity of balloons, so Horace and Oswald (the young brother) discovered a quiet spot on the eastern tip of the Isle of Sheppey, at the outlet of the Thames Estuary near Margate, where they set up sheds at a place called Leysdown, and occupied an old house called Mussel Manor, and started to build Wright biplanes. But Horace preferred to design an aeroplane of his own, on Wright lines, under Wright patents, but much better constructed.

Short Brothers' first biplane, of 1909. It was built to the order of Frank McClean and made its first flight in July of that year.

This aircraft of 1911 had an engine in front, driving two tractor screws, and another behind, driving a pusher airscrew. It was known as the "Triple Twin" or the "Triple Dud." Another had a tractor in front and a pusher behind and was called the "Tandem Twin" or the "Double Dirty."

The Short 100-h.p. tractor, designed in 1911 and flown in 1912. It is piloted by Commander Samson. Passenger in this picture is the Rt. Hon. Winston S. Churchill, then First Lord of the Admiralty, always an ardent advocate of aviation.



The Short 240-h.p. seaplane of 1917. It was a modification of the "225-h.p. Sunbeam" type and was powered with a Renault-Mercedes engine. Note the bomb racks.

Various balloonists of the Aero Club came down to "assist" (in the French sense), among them the Hon. Charles Rolls (of Rolls-Royce) who was killed by the breaking of a French-built Wright in 1909, young Mr. J. T. C. Brabazon, now Lord Brabazon of Tara, and Mr. Frank McClean, a wealthy coal-owner. Brabazon had a Short biplane built for him and in it won the *Daily Mail* £1,000 prize in 1909 for flying a mile in a closed circuit in an all-British aeroplane. He also imported a French Voisin biplane and on it qualified for Pilot's Certificate No. 1. (You may see his little sports car in London today, bearing the registration plate FLY 1.)

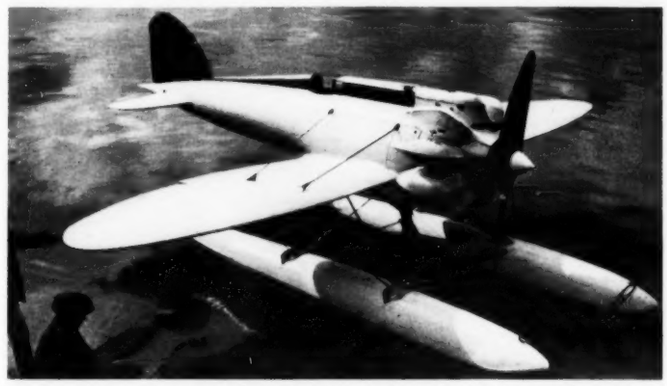
By early 1909, Frank McClean bought a large tract of land at Eastchurch, farther west on the Isle of Sheppey, and induced the Short Bros. to move there and build a proper factory—though with corrugated iron roof and sides.—At about the same time Their Lordships of the Admiralty graciously allowed three officers to draw full pay while learning to fly :—Lieut. (soon Commander) C. R. Samson, Lieut. Reginald Gregory, Lieut. A. M. Longmore (all R.N.) and Capt. Louis Gerrard, Royal Marines. Frank McClean ordered three biplanes, of Farman type, with Gnome engines, to be built for the instruction of these officers, and one of the first pilots of the Aero Club, Mr. George Cockburn (pronounced Co-burn), who was the only British representative at the Reims Meeting in August 1909, volunteered to act as their instructor at his own expense.

Thus the Royal Navy had its first four pilots, three of whom rose to high rank, trained entirely by private enterprise, and at the expense of private individuals, except for their pay, and the pay and feeding of a few "ratings" who were allowed to accompany them. That was the beginning not only of the Royal Naval Air Service, which so distinguished itself in the war until it was merged into the R.A.F. in 1918, but it was the beginning of the fortunes of Short Bros., Ltd., which has all through its 40 years of existence been closely associated with the Navy—and later with water-based civil air transport.

Shorts' early aircraft, after they gave up the Wright tail-first type as impossible to develop (a dead-end design or cul-de-sac type), were all built on the lines of Farman box-kites. But these developed in queer ways; one had a Gnome in front driving two tractor screws by chains, and a Gnome behind the pilot driving a propeller—this was known as the "Triple Dud." Another had a tractor in front and a pusher behind and was called the "Double Dirty"—the young Naval officers had no respect for the great Horace Short, but they loved him dearly.

Then Horace decided to make float seaplanes, with tractor screws. Commander Samson, and Lieut. Gregory and Lieut. Longmore had all flown pushers off platforms built over the fore-decks of warships, but they as pilots and Horace as an engineer made up their minds that the tractor type was best for sea work, because of spray damaging the propeller behind.

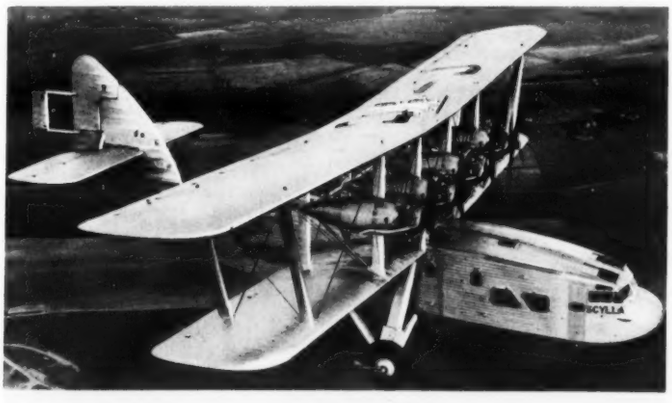
Also, the Navy's engineers wanted to fold their wings when the machines were stowed on deck, so Horace designed a folding wing arrangement, which has been the rule in all navies ever since 1913.—



The "Crusader," a freak completed in 1927 to designs of Carter (designer of the "Meteor" jet fighter) for the 1927 Schneider Trophy at Venice, to pit the Bristol "Mercury" radial against the "in-lines." It turned over on Schofield, the pilot, because the aileron wires were crossed. When dredged up only the *inside* of the engine remained. The rest, made of magnesium, had dissolved in the salt Adriatic.

The "Kent" of 1931, first of the big four-engined jobs for Imperial Airways and forerunner of the Empire Boats. A very fine craft indeed.

A nightmare :—The wings and tail of a "Kent" stuck on a landplane fuselage. Only two ("Scylla" and "Syrian") were built. One was blown base-over-apex at Brussels, and that sealed their fate.



At this time there were many queer types of privately-owned aircraft at Eastchurch, among them a big biplane with swept-back wings and no tail—quite in the 1949 vogue—built by a Lieut. Dunne. He had with him a young engineer named C. R. Fairey, who transferred to Shorts, and became their Works Manager. He is now Sir Richard Fairey, head of the great Fairey Aviation Co., Ltd.

The Short twin-float folding-wing seaplanes, commonly known as Short Folders, became standard equipment in the Royal Naval Air Service, when it was formed in 1914, just before the war. All through the war, until 1919, Short Folders did our anti-submarine coastal patrols, and worked in the Mediterranean more in co-operation with the Army at Gallipoli (until it was abandoned) and in Palestine and the Balkans, than with the Navy proper, which refused to have anything to do with this bastard sea-air service. But the Shorts did well ; so well that they set up great new works at Rochester, on the Medway, and at Bedford.

The "C" Class Empire flying-boat of 1936, the first of the long range of eminently successful "Empire" boats. George Woods Humphery ordered the "C" Class off the drawing board and never regretted it.

The "Short-Mayo" Composite Aircraft of 1937. D. C. T. Bennett, then an Imperial Airways pilot, later Air Vice-Marshal and leader of Bomber Command's "Pathfinders," and finally the controversial executive of British South American Airways, flew the top part (the "Mercury") across the North Atlantic.

The Short "Stirling" heavy bomber of 1939. It *could* lift more than any other bomber but was too slow compared with other big stuff.

The "Seaford" long-range patrol bomber of R.A.F. Coastal Command. It was the latest development (1945) of the very similar Short "Sunderland," which did outstanding work during the war.

During the war the great Horace died, and Oswald, who had always been looked upon as the "kid brother," took charge. Eustace was a director, but took no active part in the work. And when the war stopped there were no orders for aircraft, at any rate not for big seaplanes.

So Oswald started making Thames barges, and fishing boats and motor boats. Then he got some orders for bodies for motor buses. These increased until almost all the buses of the London General Omnibus Co. and of many of the great provincial cities bore the name-plate "Short Brothers, Rochester & Bedford." Several years later, when the Rochester works were busy making flying-boats, Oswald told me with justifiable pride that he had never had fewer men on his pay-roll than he had on Armistice Day, 1918—and that was when every aircraft firm was working to full capacity.

The money the firm made out of barges and buses was largely spent on experiments with aircraft. Oswald built the first all-metal machine in England in 1923. It looked like a standard tractor biplane two-seater in the 350-h.p. class, but fuselage, undercarriage, wing-spars, wing-covering, tail, elevators, ailerons and all were made of aluminium or duralumin. It flew well, but it was never reproduced in quantities.

It did so well as an experiment that the Air Ministry sent a Felixstowe flying-boat to Shorts, with orders to build an all-metal hull for it. And that was the beginning of Shorts' all-metal flying-boats. Shorts built a number of very successful flying-boats with metal hulls, some of which were used by R.A.F. Coastal Command, and some by Imperial Airways, which took to using flying-boats across the Mediterranean from Italy to Egypt in 1924.—The three-engined "Calcutta" and, in 1928, the four-engined "Kent," all biplanes with metal hulls and spars but fabric covering to the wings, did excellent service until 1934. (The biggest was one with six Kestral engines—three lots in tandem.)

Then George Woods Humphery, who had built up Imperial Airways, gave Short Bros. an order to build a series of monoplane flying boats, straight off the drawing board, as designed by Arthur Gouge (later Sir Arthur, designer of the huge "Dollar Princesses" now being built by Saunders-Roe Ltd. of Cowes, Isle of Wight). These were known as the "Empire Boats." They were full-scale versions of small land-planes with four Pobjoy engines of 90 h.p. each which had been built as flying models, and flew well. At first the Empire boats were used from England to Egypt, across France and Italy. Then they were extended up the Nile and across Kenya and down the coast to Durban, Natal. Then they were taken across Arabia and down the Persian Gulf to Karachi and across India to Calcutta, and down Burma and Malaya to Singapore. There they were met by more Empire boats owned by Qantas Empire Airways, and passengers were taken on to Australia and ultimately to New Zealand—the end of the British Commonwealth Empire airway. For this magnificent work—the longest airway in the world—credit *must* be given to Woods Humphery and to Hudson Fysh of Qantas. Twenty-eight of these big boats were built.

When war cut the Imperial Air Route the Empire boats still flew a "horse-shoe route" from Durban to Egypt to India to Australia and back, until the Japanese cut the line. The Australia-New Zealand line, known as the Tasman Airway, was all that was left.

But meantime, Shorts had been developing the Empire boats. Before the war a bigger type had been built for the North Atlantic route and trials trips had been made. Also, a heavier and stronger type had been produced for R.A.F. Coastal Command, and called the "Sunderland." These boats were responsible for constant patrol of home waters, far out into the oceans.

Later came the Solents, and Sandringhams, and Plymouths, all improvements with greater power and longer range. Since the war stopped these have done regular passenger work to South Africa all the way to Japan.

The Short "Sturgeon" of 1945, a carrier-born reconnaissance aircraft. It is reputed to be very fast.

The Short "Sealand" amphibian, a jolly little eight-seater, just the thing for inter-island passengers and mails.

Eustace Short died before the 1939 war, in a most peculiar way. He had learned to fly after 1918, though he still took no part in the business. One day he was flying a small two-seat float-plane and alighted faultlessly on the river in front of the works. As he did not stand up to moor the machine a boat was sent out to him, and he was found dead in the cockpit.

Oswald Short was Managing Director and Arthur Gouge was General Manager when, in 1936, an alliance was formed with Harland & Wolff, Ltd., the great ship-builders of Belfast, and a new firm Short & Harland, Ltd. was registered. An enormous factory was built on reclaimed land, which formed an extension of Queen's Island on which the Harland & Wolff works stood. There various warplanes were built, till flying-boats of the newer types were put into full production.

Before and during the war, Short Bros. built a big four-engined monoplane bomber land-plane called the Stirling, which was much used in the earlier years of the war. It could lift heavier loads than any of its contemporaries.

In 1942 the shares in Short Bros. Ltd. were compulsorily acquired by the Government and various Government nominees were appointed to the Board. In recognition of his outstanding services Mr. Oswald Short was appointed Honorary Life President. Mr. E. D. A. Herbert became Chairman. By 1949 Short Bros. as such had merged into Short & Harland and, with a large body of distinguished Directors, seemed to be heading for a fresh career of peace-time usefulness.

What's in the Air?*

AIR TRANSPORTATION

Jet Discussion Continues . . .

Questions of commercial airline equipment accounted for a large proportion of aeronautical news in the past few weeks. In the foreground continue to be speculations whether or not Great Britain will able to wrest dominance from the U.S.A. in the field of commercial transport aircraft operation and sales. American manufacturers have expressed dismay at the fact that Britain has half a dozen gas-turbine powered transport prototypes in the air ("Comet," "Hermes 5," "Viscount," "Apollo," "Marathon 2," as well as Avro-Canada's C-102 "Jetliner.)" They are renewing their pressure on the U.S. Legislature to pass a Prototype Bill which would saddle the Government with engineering costs of jet transport designs and establish for the U.S. industry a parity with Britain's Governmental subsidy of jet transports. Leader of the movement is the Boeing Airplane Co. which announced in the middle of September that it could have a 500-m.p.h. jet transport prototype in the air within eighteen months of receiving a contract.

U.S. airline companies are known to have been in conference with U.S. manufacturers for many years on a multitude of jet transport ideas. American Airlines at one time favoured Northrop's "Flying-Wing" designs. T.W.A. developed a whole range of jet-transport configurations, one of which strongly resembled the Boeing B-47 bomber. United Air Lines at one time considered a jet-powered Martin cargo transport.

A large proportion of the American manufacturers' tears are certainly attributable to the proverbial crocodile. First of all, it will be several years before production models of Britain's gas-turbine transports will be available for commercial operation. Secondly, even if they were available today, the world's major air carriers would have little use for them because the equipment they have bought since the war will be good—as T.W.A. President Ralph Damon told INTERAVIA on October 21st—for at least another five years. This means that U.S. manufacturers have ample time to get ready new jet transports for the time when the airlines' present academic "interest" converts itself into a concrete demand, complete with cheque-book.

That U.S. manufacturers are clearing the decks for all-out jet transport development is proved not only by the Boeing statement but also by an "employee memorandum" issued by Lockheed President Robert E. Gross, announcing an "alteration" in the company's development programme. Other manufacturers, such as Consolidated Vultee and Douglas, are reported to have completed plans for the design of jet transports or the adaptation of existing types for use with gas turbine engines.

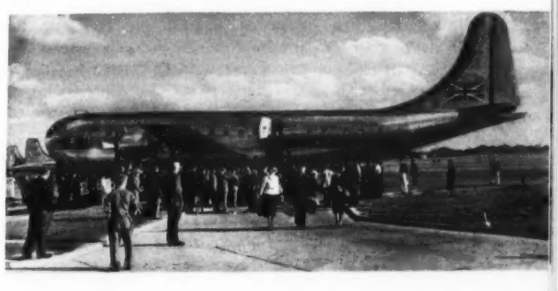
Mild Airline Buying Spree Continues

Meanwhile, large and small airlines have continued to sign contracts for new aircraft or put into service equipment ordered long ago. Contracts closed in the Sterling area show a sprinkling of gas-turbine powered aircraft, but the majority of orders in the past few weeks was for conventional piston-engined types.

In *Great Britain* B.O.A.C. has on order a total of *14 D.H. "Comets"* four-jet transports. B.O.A.C. has also ordered *25 Bristol 175 Medium-Range Empire (MRE)* four-engined propeller-turbine powered aircraft (roughly of "Constellation" size) for delivery in 1952 and scheduled service in 1953 or even 1954 (Ralph Damon's "five years" again !). The third gas turbine type ordered by B.O.A.C. is the *Vickers "Viscount,"* of which about a dozen will go to the line's subsidiary, British West Indian Airways. On the other hand the corporation has begun to take delivery of its ten *Boeing "Stratocruisers,"* the first of which arrived in England on October 15th ; they will go into scheduled operation next January. Into regular service at the end of August went some of the corporation's Canadian DC-4M2 "Argonauts" to replace the eleven Short "Sandringham" flying-boats on the Far East route. On September 6th they were again withdrawn because of a minor engine defect ; Rolls-Royce Ltd. took "urgent remedial action," and they returned to operation on October 11th.

The fact that B.O.A.C. has retired its "Sandringhams" does not mean that the line is "antipathetic" to flying-

The first of B.O.A.C.'s ten Boeing "Stratocruisers" arrived at London Airport, Heathrow, on October 15th. Captain W. S. ("Bill") May flew it non-stop from New York.



* Based on reports in the daily "Interavia Air Letter."

boats, Chairman Sir Miles Thomas stated in August. Quite on the contrary, he had called for a report on the economic and operational possibilities of a six-jet flying-boat accommodating 50 to 60 passengers and cruising at 400 m.p.h. on Commonwealth and Atlantic routes. Sir Miles did not disclose if this means that he is not so sure whether he really wants the three ten-engined turboprop-powered 105-passenger SR/45 boats now building for B.O.A.C.

Finally, B.O.A.C. has informed the Ministry of Civil Aviation that it does not intend to take delivery of the ten "Tudor 2" freighter aircraft which are being modified to the requirements of the Ministry, as they were too expensive. Shortly after, about the middle of October, A. V. Roe & Co., Ltd., manufacturers of the unfortunate "Tudor" series of transports, issued a release refuting the prolonged criticism of the "Tudor" and showing by means of statistics that the type is basically sound and economic in operation.

British European Airways Corporation, armed with the knowledge that under the Government's new policy it may order the type of aircraft it really wants, has rejected all existing designs of small British feeder liner as a replacement for the veteran D.H 89 "Dragon Rapide" twin-engined biplane. It therefore has invited designs for a miniature four-engined airliner

The Vickers-Armstrongs "Viscount 700" turboprop airliner has been ordered by B.E.A.C. and several other companies. It will be larger than the "Viscount" prototype (shown here).

for service in 1952 ; an initial order for 15 would be placed. The smallness of the order seems to offer little inducement to aircraft manufacturers to start work on an entirely new design.

B.E.A.C. is also conducting negotiations for a number of "Viscount 700" propeller-turbine airliners for operation in 1953.

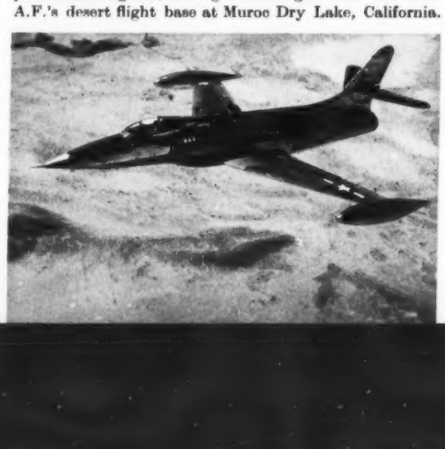
Major airlines in British Empire countries, too, continued their cautious procurement programmes. *Australian National Airways* has placed an order—conditional on certain specifications being met—for ten Vickers "Viscount 700" turboprop airliners ; the first aircraft is to be delivered late in 1951 or early in 1952. In the meantime, A.N.A. is endeavouring to obtain additional Douglas DC-4s, and on October 19th the company complained that the Australian Customs and Treasury authorities have been holding up import licences for two such aircraft which had been approved by the Civil Aviation Department. The Australian Government air carrier, *Trans-Australia Airlines* is also sounding the gas-turbine market and seems to be hesitating between a batch of ten Vickers "Viscounts" or an equal number of Avro-Canada C-102 "Jetliners"; a "Jetliner" is scheduled to go to Australia on a demonstration tour in 1950, and T.A.A. is expected to use it for operations tests as a freighter. Concerning its existing fleet T.A.A. announced good news : the company's first "Convair-Liner" recently underwent its first tear-down inspection after 2,000 hours of flying and came through the examination with a perfectly clean bill.—*Tasman Empire Airways* at the beginning of October took delivery of the first of four Short "Solent IV" flying-boats to replace its "Sandringhams" on the Sydney-Auckland service.—*Air India International* has received the first "Constellation 749" of a repeat order for two ; the second will be delivered in January, bringing the company's fleet to five such aircraft.—*Universal Airways,* the Johannesburg private carrier, is seeking to buy four-engined aircraft in Europe for its service to Israel ; payment would be made in Sterling.—*Central African Airways Corporation* has returned its two Bristol 170 aircraft to the British Ministry of Civil Aviation, from which they were hired. No provision is made for their use under the Corporation's rationalized operating programme.—*Canadian Pacific Air Lines* is expected to order additional "Canadair-Four" transports to supplement the four it now operates on the Pacific run.

Recent contracts from *United States* carriers have been confined to well-proven types. *United Air Lines* has placed an order for five additional Douglas DC-6 airliners at a cost of approximately $4,329,800. Delivery will start in March, 1950, and give the company a fleet of 44 such aircraft. Early in October, U.A.L. took delivery of the first of its seven Boeing "Stratocruisers"; they will initially operate on the San Francisco—Honolulu route. Meanwhile, wide attention was attracted by U.A.L. President Patterson's statement in San Francisco October 5th that he did not intend buying any jet transports from Britain even if they were better than American machines.—*National Airlines* announced in the middle of October that it is buying two more Douglas DC-6s to supplement its four aircraft of the type, to be delivered next spring.—To finance the twenty Lockheed L-749 "Constellations" it ordered in June for delivery in 1950, *Trans World Airline* has obtained a $12,000,000 loan from the Mellon National Bank & Trust Company, of Pittsburgh.—Five aircraft of the same type, costing between $5,000,000 and $6,000,000 have been ordered by *Chicago & Southern Air Lines,* the company stated September 23rd. An order for three more was announced October 13th by *Capital Airlines* ; the aircraft are being bought under a novel agreement, whereby Lockheed Aircraft Corp. agrees to lease the aircraft to Capital for 18 months for $17,500 a month each, with the rental to be applied towards the purchase price of $684,000 each. Capital also announced that it will have three of its Douglas DC-3s converted into "Super DC-3s." Washington reports indicate that the company's entire fleet of 23 DC-3s will eventually be converted in this manner. Among U.S. certificated cargo carriers, the *Flying Tiger Line* has acquired five more Curtiss C-46 "Commando" twin-engined cargo transports and one Douglas C-54 "Skymaster" (DC-4) to handle service extensions authorized under the five-year operating licence granted to the company by the C.A.B.

In South America, *Lloyd Aereo Boliviano* has bought an additional four Douglas DC-3s. Two of them replace aircraft destroyed in the recent civil war.—To secure delivery of the five "Convair-Liners" ordered for *F.A.M.A.* in 1947, the Argentine Transport Ministry has made a down payment of $176,000 ; delivery had been delayed by Argentina's lack of dollars. A second payment of $400,000 will follow shortly. Apparently the machines will be used on the domestic services of *ZONDA* and *Aeroposta.*

In *Europe,* too, airlines are still busy completing their equipment. *Air France* announces that it will receive the two first Sud-Est SE 2010 "Armagnac" four-engined luxury transports in 1950. On the other side of the picture, the company is understood to have decided to withdraw its "Languedoc 161" four-engined airliners from passenger service in Europe ; some of them will be used as freighters. Belgium's *Sabena*

The Lockheed F-90, new single-seater twin-engined penetration fighter, during a test-flight over the U.S. A.F.'s desert flight base at Muroc Dry Lake, California.



Avro-Canada's C-102 "Jetliner" is expected to go on an Australian demonstration tour in 1950. Picture shows the flight crew conducting the present flight tests. *Left to right :* Project Designer J. C. Floyd ; Avro-England Chief Test Pilot J. H. Orrell ; Flight Engineer A. W. Baker. Avro-Canada Chief Test Pilot D. H. Rogers ; Assistant Production Manager H. Garside ; Avro-Canada Vice-President and General Manager W. N. Deisher.

has ordered two additional Douglas DC-6s to supplement the three in service on the company's North Atlantic and South Africa routes. Sabena also proposes to buy additional Douglas DC-3s and de Havilland "Doves" to boost its passenger and cargo services in the Belgian Congo, where special air services for natives are to be introduced.

Swissair on September 23rd held an extraordinary general meeting to obtain approval of the purchase of three long-range aircraft for the Atlantic service ("Constellations" or DC-6s). The proposal was voted, but Swissair's management subsequently decided not to place any orders until it had studied the extent of the detrimental effect on the company's operations of the recent wave of monetary devaluation. Sweden's *A.B. Aerotransport* reportedly will receive only six SAAB "Scandia" twin-engined airliners of the ten ordered originally, as Svenska Aeroplan A.B., the manufacturer, is overloaded with military work. The six "Scandias" will be delivered in 1950.

A portentous development has taken place in *Italy* in the form of an agreement between *Avio Linee Italiane—Flotte Riunite* and *Pan American Airways* under which ALI will buy four Lockheed L-649 "Constellations" from P.A.A. on advantageous terms. The State-owned LATI airline will probably associate itself with the agreement in view of LATI's projected merger with ALI, which is required by the Government prior to the issue of a Rome—New York operating licence to either company. Through the equipment agreement P.A.A. secures itself a direct or indirect interest in the largest Italian domestic and future overseas operator, thereby offsetting T.W.A.'s interest in Linee Aeree Italiane and B.E.A.C.'s participation in Alitalia. It is considered likely that both T.W.A. and B.E.A.C. will ultimately withdraw from their Italian affiliates, thus opening the way for the establishment of a single Italian national airline—with which Pan American Airways would obviously endeavour to maintain the closest possible relations. Avio Linee will pay for the equipment out of a $4,500,00 E.C.A. grant it has obtained for the purpose. Other grants in similar amounts have been awarded also to Alitalia and LAI for the purchase of American long-range aircraft.

Ceskoslovenske Aerolinie (C.S.A.), Czech State line, discloses that it has a total of eight Russian Ilyushin Il-12 twin-engined transports on order. Some of them have already been delivered. The Polish *Polskie Linie Lotnicze* (LOT), on the other hand, has taken delivery of 12 machines of the type. It is unknown what happened to the Ilyushin Il-18 four-engined airliners which both C.S.A. and LOT were once reported to have ordered in Moscow.

In *North Africa,* Egypt's *Misrair* has bought the three Vickers "Vikings" which the Danish D.D.L. has been anxious to sell for some time. Misrair's "Viking" fleet now amounts to eight aircraft. *Air*

Maroc, of French Morocco, has bought three Curtiss C-46 "Commando" transports which were overhauled at Buffalo, N.Y., for delivery early this month.

International Air Transport Trends and Developments

Countries of the Arab League, after their military defeat at the hands of Israel, are discussing their situation in the light of Israel's activities to attract international airlines to Lydda airport, near Jerusalem, and to Haifa airport, now being expanded. Arab countries would certainly suffer financial repercussions if international air services were diverted from Cairo and Damascus to Israeli airports. First results of the Arab discussions are the expansion and modernization of Khaldy airport, Beirut; El Mazza airport, Damascus; as well as some of the Egyptian airports. Observers believe that Egypt will remain the air crossroads in the Middle East but expect Israel to become increasingly important as a staging post on long-distance routes between Atlantic and Far East countries.

In the field of high-level diplomacy, about half a dozen *bilateral air agreements* were signed in the four weeks to the middle of October. Negotiations for a similar number were in progress. Most outstanding failure continues to be the non-implementation by the Americans of the U.S.-Canadian air agreement giving Canadian operators the right to fly to various points in the U.S.A., U.S. operators to fly services to Canadian points and use Gander on the Atlantic routes. Unless U.S. implementation of the agreement is obtained in the near future, the Canadians may cancel U.S. operating rights at Gander.

An important effect on air transport developments has been exercised by the *currency devaluation* which followed the pound-sterling devaluation on September 18th. Operators flying to the U.S.A. had to jack up their rates to keep them in line with dollar fares. Travellers from hard-currency countries, on the other hand, now find air travel in "soft" areas much cheaper than before. For example, it costs less today to fly 12,000 miles from Sydney to London (£260) than 9,000 miles from Sydney to New York (£285). The devaluation already has had a salutary effect inasmuch as eastbound Atlantic air travel has increased considerably instead of slumping seasonally. American Overseas Airlines, for instance, reports full eastbound bookings for weeks ahead.

New Helicopter Operators

Paul Codos, veteran French airman and Atlantic pilot, has formed a helicopter operating company, in Casablanca, *Morocyr*, specializing in agricultural work. It will start operations in January with two Hiller 360 helicopters.

A similar company has been established at Hanapepe, Kauai Island, Hawaii, under the name of *Helicopter Services of Hawoii*. It will perform spraying operations.

Veteran French airman Paul Codos has founded a helicopter operating company in Morocco.

AEROPLANE NEWS

Every time the editor of these news items glances through the achievements of the aircraft industry in the space of five or six weeks he is amazed at the breathtaking speed of aeronautical progress (see also pages 662 and 663 of this issue). The following samples, ranging from early September to the middle of October will impress you, too.

A Consolidated Vultee B-36D heavy bomber equipped with four General Electric J-47 turbojets of 5,200 lbs. (2,360 kg) thrust in addition to its six Pratt & Whitney "Wasp Major" piston engines is reported to have attained a maximum speed of 435 miles per hour at an altitude of 50,000 ft. For the transport counterpart of the B-36, the *Consolidated Vultee C-99*, Convair

B.O.A.C. has ordered 25 Bristol 175 M. R. E. four-engined turboprop airliners. Two prototypes are under construction.

has worked out loading facilities permitting the handling of very heavy items. For its twin-engined "*Convair-Liner*," Consolidated Vultee has asked the C.A.A. for an increase in the certificated take-off gross weight from 40,500 lbs. to 41,200 lbs.

The Boeing Airplane Co. has fitted six General Electric J-47 turbojet engines of more than 5,000 lbs. thrust each to the production version of the *Boeing B-47* "Stratojet" bomber. The new power plant gives the aircraft a 25-percent power gain over the prototype. Incidentally, it is generally assumed that Boeing Vice-President Wellwood E. Beall was alluding to a commercial version of the B-47 when he announced on September 17th that America could have a superior type of jet transport in the air about 18 months after the signing of a contract.

In *France*, the final assembly of the first production model of the Bréguet 761 cargo transport, the well-known "Deux-Ponts," was progressing rapidly at Villacoublay, and the aircraft was scheduled to fly at the end of last month. It has also been announced in Paris that in addition to the prototype of the *NC 211* "*Cormoran*" four-engined cargo aircraft—a much maligned type which has consistently refused to comply with its critics' gloomy predictions—seven production models will be built. Another—though smaller—cargo transport, the *Fouga CM. 100* twin-engined type, is to be fitted with two Turbomeca low-power turbojets of the type used in the Fouga "Cyclone" powered glider; in the CM. 100 the two engines will provide added thrust for take-off.

Morane-Saulnier's MS 730 twin-engined personal transport, one of the neatest jobs in its category, made its first flight on August 1st and by October 1st had accumulated 30 flying hours.

In the jet field, France has started flight tests of her *Sud-Ouest SO 6021 single-jet fighter*, a development of the SO/6020 "Espadon" with lateral air intakes. The aircraft is at the Orléans-Bricy test centre. Theoretical work on the *SO 4000 twin-jet bomber* project is also advancing: on September 26th the SO M1 flying model was launched for the first time over Orléans-Bricy; previously it had made numerous flights attached to a "Languedoc" transport.

Great Britain continues in the news with her gas-turbine powered commercial transports. On October 25th the *D.H. 106* "*Comet*" made a return flight from London to Tripoli, a total distance of 2,978 miles, in a flying time of 6 hours 36 minutes. The aircraft stopped 2 hours 8 minutes at Castel Benito, probably to refuel. Round trip average flying speed was about 450 m.p.h. Another gas turbine type, the *Vickers-Armstrongs* "*Viking*" turboprop airliner, aggregated 290 hours of flying and 320 take-offs from the middle of July, 1948, when it made its first flight, to the middle of October, 1949. On September 20th the manufacturers announced that the aircraft has been granted its Certificate of Airworthiness. Vickers-Armstrongs are expecting initial orders for about 50 aircraft of the enlarged development, the "Viscount 700," with deliveries beginning in 1952. Each "Viscount" will cost about £170,000.—It has also been announced that two prototypes of the *Bristol 175 M.R.E.* four-engined turboprop aircraft are building. B.O.A.C. has ordered 25 machines.

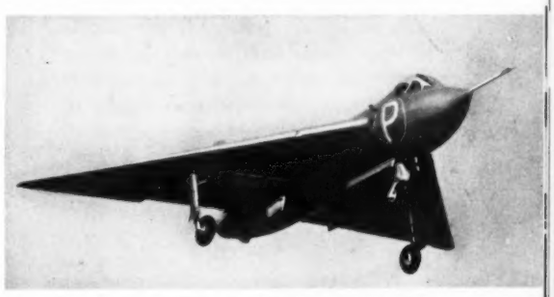
Jet bomber news include the report that *A.V. Roe & Co. Ltd.* is completing a long-range jet-powered *delta-wing bomber*. Apparently this will be an enlarged version of the revolutionary *Avro 707* delta-wing experimental aircraft which crashed September 30th at Blackbushe Airport, Surrey, killing Avro Chief Pilot S. E. Esler. A second prototype of the 707 has now left the factory. Meanwhile hush-hush negotiations are reportedly going on for the manufacture of the *English Electric* "*Canberra*" twin-jet medium bomber in Australia.

Talks for the manufacture of the *de Havilland* "*Vampire*" jet fighter and the "*Ghost*" gas-turbine engine have successfully been concluded with Italy. "Vampires" and "Ghosts" are being imported from Britain to aid the Fiat, Macchi and Alfa-Romeo companies in starting this production.

Canada's Avro C-102 "*Jetliner*" four-engined transport prototype has recovered from the slight damage it received in a belly landing some weeks ago and made a demonstration flight before American, British and Canadian observers October 4th. By then it had logged about ten hours of test flying. Price of the production model will be about $700,000, total development costs about $10,000,000 to $12,000,000. Components for the second prototype are ready, but assembly will be delayed to enable incorporation of eventual modifications. Avro-Canada's second jet aircraft, the *XC-100 experimental fighter*, will shortly make its maiden flight.

Another Canadian company, the *Canadian Car & Foundry Co.*, is making plans to revitalize its aircraft manufacturing activities: its aircraft division at Fort William, Ontario, reportedly is to be equipped for the conversion of Douglas DC-3s into "Super DC-3s."

Australia not only is negotiating for the manufacturing rights (see above) but also prepares to extend the production of its own designs. So it was



From the Avro 707 Delta-wing experimental aircraft (above), A. V. Roe is reported to be developing a Delta-wing jet bomber. The 707 crashed recently, but a second prototype has been completed.

announced in October that the Commonwealth Aircraft Corp. Pty., Ltd., of Fishermen's Bend, Melbourne, will start production of a twin-jet long-range all-weather attack fighter. The project has been specifically approved by the Australian Government. The type reportedly is basically similar to the Lockheed XF-90.

The *Turkish Air League* (Türk Hava Kurumu, T.H.K.) is developing three new aircraft types at its Ankara-Etimesüt plant: a twin-engined 12-passenger light feeder aircraft designated *T.H.K. 12* and powered by 600-h.p. P. & W. R-1340 "Wasp" radials; the *T.H.K. 14* two-seater glider and the *T.H.K. 15* single-engined all-metal tandem two-seater primary trainer.

The *Finnish* State Aircraft Factory, *Valtion Lentokonetehas*, is constructing the prototype of a single-engined military trainer, the "*Vihuri*," to replace the VL "Pyry" two-seater low-wing advanced trainer. The "Vihuri" is a low-wing all-metal monoplane powered with a licence-built 840-h.p. Bristol "Mercury" radial. Its top speed will exceed 250 m.p.h.

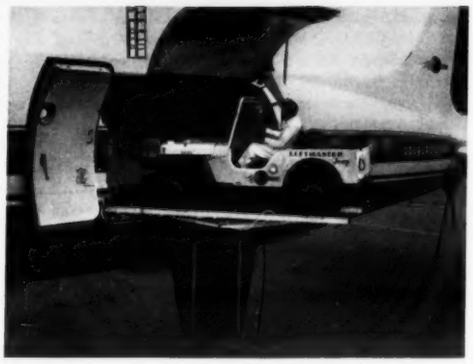
TAIL-PEACE

The last Douglas C-54 "Skymaster" of the U.S.A.F. "Berlin Air Lift" operation landed at Berlin-Tempelhof September 30th and was "dismissed" with a simple little ceremony. The British part of the air lift ended October 6th with the practically unnoticed landing of an R.A.F. Handley Page "Hastings" at Gatow Airport.

Progress in Pictures

New Aircraft

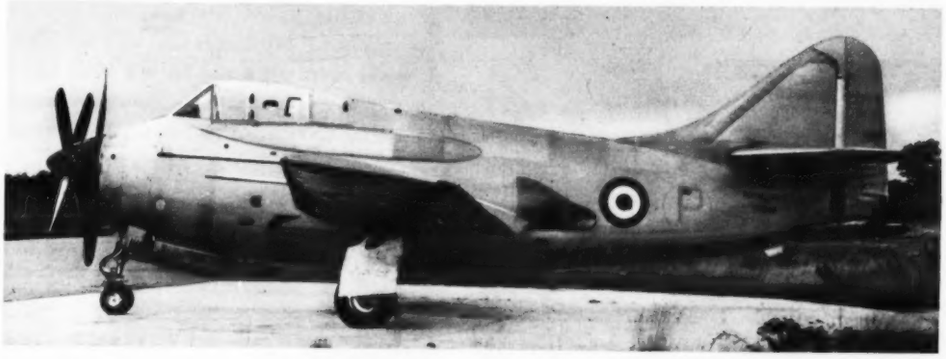
DOUGLAS AIRCRAFT COMPANY'S NEW DC-6A "LIFTMASTER," designed exclusively to carry cargo, is shown here making its first flight on September 29th. Based on the design of the familiar DC-6 airliner, the long-range, 300-m.p.h. cargo transport likewise has a pressurized, air-conditioned cabin but features a fuselage longer by five feet and two large cargo doors, one of them with a built-in power lift. It can haul some 30,000 lbs. of cargo more than 2,100 miles non-stop.—The next two steps on the DC-6 development programme have already been announced. First, a DC-6B passenger version of the DC-6A, capable of seating over one hundred passengers. And second—though as yet in the undecided planning stage—a jet version of the DC-6, with a swept-back fin and a high-set elevator to be clear of the jet stream from four turbojets paired in two nacelles slung beneath the wing.

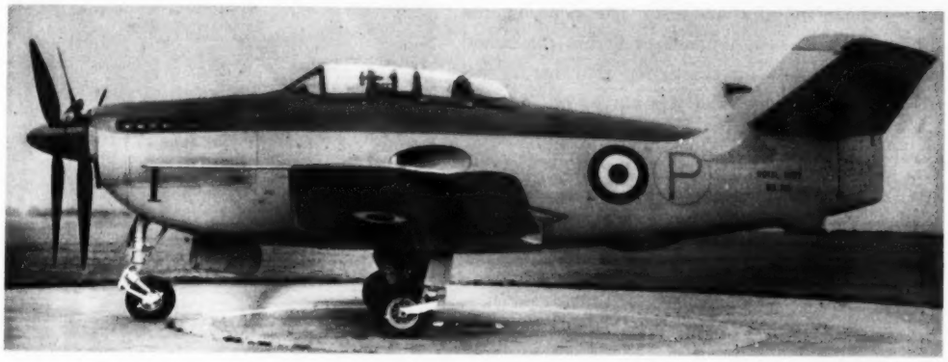


CONVAIR'S T-29 "FLYING CLASSROOM," the U.S. Air Force's new navigational trainer, has the same power plant as the Chase C-123 but is smaller and lighter. Flight tests commenced on September 22nd and thirty-six units are now under construction for the Air Force. Pupils have an abundance of equipment at their disposal: four astrodomes on top of the fuselage are provided for the fourteen students and instructors; in the cabin fourteen card-tables are fitted with all the standard navigational instruments as well as special electronic units; the large bulge beneath the fuselage, forward of the wing, is the radome for use with radar equipment; only some of the eighteen antennae are visible in this photo. Pressurized cabin, fuel supply for ten hours' flying, and a 250-m.p.h. cruising speed promise exciting "school outings" for the pupils of America's globe-girdling Air Force. Incidentally, the T-29—as also the T-32 bombing trainer due to follow it—must strike a familiar note even with the non-military people of all countries: yes, they're just converted "Convair-Liners."

ANOTHER "SAGGING SAUSAGE," with functions very similar to those of the U.S. Navy's Piasecki twin-rotor assault helicopter which gave birth to that name, is brought to mind by the U.S. Air Force's newest assault aircraft, the Chase C-123, designed by Chase Aircraft Company, of Trenton, N.J., for transporting up to sixty fully-equipped combat personnel into small, unprepared fields in forward combat areas. Two Pratt & Whitney R-2800 engines of 2,400 h.p. each, enable the C-123 to take off within 1,020 feet over a 50-foot screen and land within 1,440 feet behind a similar obstacle; the cruising speed of 266 m.p.h. and range of 550 miles are, on the other hand, modest in comparison. Whether these design data can be met is now being ascertained in the prototype flight tests which began on October 14th at West Trenton.

ANOTHER FIGHTER TRAINER for the U.S. Air Force's aspirant fighter pilots, so that they needn't envy their navigator colleagues, has now been provided by North American Aviation, Inc., in the two-seat T-28, the prototype of which flew four days later than the T-29. The first U.S. trainer to have a tricycle landing gear, the T-28 offers, even to beginners, the advantage of characteristics found otherwise only in front-line machines : good visibility and controllability during take-offs and landings ; high speed thanks to an 800-h.p. seven-cylinder Wright radial, also enabling the more advanced pilots to prove that they are ready to handle today's ultra fast jet fighters and bombers.





NEW BRITISH DISCLOSURES made since last September's S.B.A.C. Display are two carrier-borne anti-submarine aircraft for the Royal Navy's air arm, which, in view of their mission, probably can carry a substantial bomb-load in relation to their dimensions. On the left is the Fairey 17, the first aircraft to be powered with a "Double Mamba" (two Armstrong Siddeley "Mamba" turboprops coupled to drive contra-rotating propellers, furnishing together 2,540 h.p. take-off power) ; it is likely that one unit can be cut to give more economic performance for longer trips. The Blackburn Y.A. 5, the other new aircraft, is shown here fitted with a Rolls-Royce "Griffon" piston engine of about 2,500 h.p., but later aircraft of this type will also be powered with a turboprop power plant.

AMONG ITALY'S ATTRACTIONS is now the Macchi M.B. 320, a small twin-engined feeder transport for six occupants, which recently started its flight trials. The main structural material is plywood ; the engines are American—185-h.p. Continental flat-sixes. The M.B. 320 is just another of those promising new aircraft which come forth occasionally from Italy's struggling aircraft firms—at a time when large sections of France's industry are barely ticking over, in an effort to improve the prospects through revolutionary changes.

On the way to Mecca : The Braathens SAFE DC-4 crosses the River Euphrates.

An Infidel Flies to Mecca

A Dane acts as King Ibn-Saud's Messenger

BY SVEND-AAGE NIELSEN

Mecca, Islam's Holy City, has always fired the imagination of explorers and press reporters. But most of those who dream of visiting the place will have to continue dreaming—the Moslems are religious fanatics and don't admit unbelievers to Mecca. Should you think of trying your luck, remember that there is one type of punishment for unauthorised entry : your head will be chopped off with an axe right on the spot where you are caught. Mecca's climate is hot, and six years ago a Persian pilgrim suddenly felt faint in the sweltering heat somewhere within the sacred area. One of the guards reported that he was drunk—and his head was lopped off in a few minutes. A war between Persia and Saudi Arabia was barely averted—another result of the terrific heat in flaming Mecca. Relations between the two countries were severed. They were resumed only recently and legations opened up again.

To celebrate the re-establishment of normal conditions, a number of high dignitaries of Persian Mohammedanism decided a few weeks ago to pay their first visit to Mecca after six years of latent hostility. For this purpose they chartered a four-engined Douglas DC-4, specially equipped for operations in the tropics, of *Braathens S.A.F.E.*, the Norwegian independent airline company. By accident I heard that an important letter was to be carried from the Saudi-Arabian Legation in Tehran to Mecca, and I lost no time in offering my services. The Legation people agreed to entrust me with this mission, and six hours before the aircraft was due to take off I started the race for the innumerable permits, visas and passport stamps required for the trip. (Persia no doubt is the Middle East's red-tape country *par excellence*.) My friends told me I was mad. I would never get a visa for the Holy City ; anyway, it would take me at least two weeks to get the visa permitting me to leave Persia.

The highest dignitary of Persian Mohammedanism. The clever face of a distinguished priest. He had no objection to being photographed. Behind him a Moslem woman, complete with veil.

Two other top-level members of Persia's Mohammedan hierarchy. The photographer had obtained special permission to take pictures of the priests, a fact which evidently was unknown to a horrified onlooker (right background) : faithful Mohammedans on their way to Mecca are not supposed to allow their picture to be taken.

Close-up of yet another passenger on the Braathens special flight. The man's expression reflects—fear, fanaticism, resentment ?

Two hours later, however, I was back at the Saudi Arabian Legation and, over a cup of strong Mocca coffee, was solemnly appointed a "Royal Saudi Arabian Messenger." The precious visa was stamped into my passport and a large envelope was handed to me.

The take-off was dramatic. The Norwegian pilots picked me up at my Teheran hotel at 02.00 hours in the morning. Twenty minutes later we drove up at the airport and found it besieged by crowds of ragged Mohammedans. Screaming and yelling, about 900 of them were making a last-minute bid to fly to their Holy City either by stowing away or by fighting their way through the gates for a "free ticket." We finally had to use the back

Baggage is unloaded by Saudi Arabian airport personnel.

door of the administration building to get to our aeroplane. A whole fleet of ancient and weird-looking aircraft were preparing to make the same trip; they included several war-surplus bombers belonging to American "free-lancers," and even their space was sold out to the last square inch. Unfortunately for us, the Braathens DC-4 was the largest and definitely smartest-looking aircraft of the lot, as a result of which the milling Persians attempted time after time to break through the police and military cordons which had been thrown around the aircraft.

We were due to take off at 03.00 hours, but Persian customs and passport officers take their time. Their task was complicated by the indescribable confusion reigning in the corridors of the administration building.

Many of the pilgrims had worked themselves up into such a state of excitement that they were hardly able to walk. Some were kneeling in the corridors, surrounded by their weeping families. Each of the passengers of the Braathens aircraft carried over his shoulder a regular kitbag, and their friends continued to bring additional luggage. I estimated that each man tried to take at least 180 pounds of hand baggage into the cabin. There were tents and large quantities of water in buckets, special water containers and smart American portable iceboxes. Some of the pilgrims carried radios. But the chief item they took along was food and more food. Food in piles—none, it was said, was to be got in Saudi Arabia. What the huge sacks and wooden cases concealed I do not know, but I suppose it was food.

After the landing at Jedda airfield, Mecca's airport. Pilgrims walk towards the coaches that are to take them to the Forbidden City. It was later found that they hadn't paid their landing tax...

Half of our forty pilgrims looked very prosperous. The other half looked so poor that I began to wonder where they had obtained the money to make the expensive trip and pay for the fantastic "landing fee" of 46 pounds Sterling per head at Mecca. After the "hand baggage" was reduced to meet the regulations, we were theoretically ready to start. But, as we were preparing to go, a tidal wave of screaming Persians, minus tickets, broke through the police cordon. Just as the aircraft began to taxi the first frenzied men reached it, and all the pilot could do was to stop the four engines and their whirling propellers immediately in order to prevent a massacre.

The Norwegian crew—all of them former underground resistance men and later members of the British Royal Air Force—rushed down the aisle where the rightful passengers were already kneeling, loudly imploring Allah to save the aircraft. The crew were not a second too early, because Persians were already climbing on to each others shoulders in an attempt to open the door from the outside. Like waves driven by a hurricane, masses of half-mad pilgrims stormed inside as soon as the door was opened. The crew was swept aside and a regular battle broke out. The Norwegians finally laid hands on some tools and started swinging them at the invaders. Slowly the would-be "non-revenue passengers" were repulsed. Soldiers with enormous bayonets on their rifles cleared the runway. Three more men were pulled out from under sacks and chairs and thrown out into the night. The aircraft was ready for taking off.

Hot winds blow in from the Red Sea to Mecca's airport at Jedda.

We had hardly left the runway when "Allah!... Allah!..." cries began to rise from the excited passengers. Some of them were on the floor, others between the huge piles of luggage, all of them engaged in the

same movement—up and down, up and down, shouting "Allah" all the time. Some looked ecstatic, some fanatic, some just scared. Only the high dignitaries sitting nearest to our very comfortable crew quarters preserved their imperturbable calm. Our Persian steward, who spoke both English and Arabic, tried to restore order and called them all back to their seats.

After a while I took a stroll down the aisle—and I must say that on all the queer flights I have been on in five Continents I have never seen such fantastic scenes in an aeroplane. The garb of the passengers varied from luxuriously beautiful robes and turbans to sheer rags. Nobody gave me a friendly look at first, but after I had spoken for a while to the top dignitary of Persian Modammedanism, who spoke perfect English, the passengers' attitude changed. I was offered everything from sweetcakes and candy to odd-looking and worse-smelling fruits. Most of these things I accepted to build up a friendly atmosphere. I wanted to take pictures, and a Mohammedan on a pilgrimage is not supposed to have his picture taken.

Meanwhile, the DC-4 was climbing. Persia possesses the world's most inhospitable desert, the *Desht Kewiir,* as well as an awe-inspiring range of mountains with peaks towering up to 16,000 and 19,000 ft. The first hour of the flight was in the dark, and only stars twinkled above our heads. Then the horizon began to glow ; dawn came just as we roared over some 13,000-ft. peaks. As soon as the sun had emerged from behind the mountains, a new wave of "Allah" cries drowned out the sound

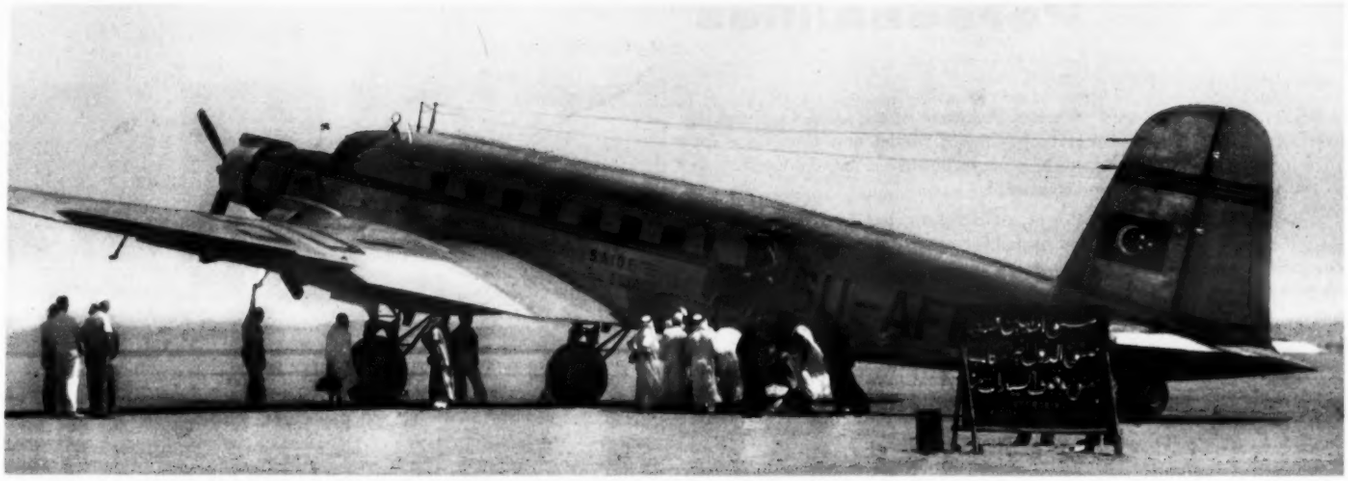
A Moslem ? Yes. An Arab ? No. His name is Abdul Krim Herbert and he lives in Mecca. Formerly plain Mr. Herbert, he was born in England.

of the four engines. I spent half my time with the crew, the other half in the cabin. In the very modern pantry we prepared a fine breakfast, complete with steaming coffee, and discussed our dramatic take-off. Sure, said the pilot, it was dramatic all right, but just wait—stranger things may happen when the pilgrims see the roofs of Mecca. You had better prepare yourself for any emergency.

Flying in the Middle East is not easy. Radio beams are scarce; you have to rely on stars, the sun, good maps and an occasional landmark. Desert and mountains look the same all the time, so you have to fly mostly on compass. We flew over some of the world's richest oil deposits but saw the first refineries only near the estuary of the Euphrates in the Persian Gulf. Shortly afterwards we passed over Kuwait where the Americans have developed an enormous petroleum industry, and then we said goodbye to the refreshing sight of the sea and flew into the vast mainland of ancient Arabia. Near the coast a little vegetation was discernible, but in the dreadful *Nefud* and *Djebel* deserts every sign of life was wiped out. When the Red Sea appeared on the horizon, the pilot began to let down gradually, and the increasing heat made us take off most of our clothes. I went back into the cabin, where most of the pilgrims had already gone into ecstasy upon perceiving the first white roofs of the Forbidden City. Some took off their ordinary clothes and unpacked neat white *Ihrams,* the regulation holy dress. Others were wrapping up their shoes—according to the Koran only old people may wear footgear in Mecca. Many were kneeling in the little space in front of the store room and sang "Allah" prayers in loud voices. Others tried to push their way to the doors to be first man out. Gradually they were all shepherded back to their seats to enable us to prepare for the landing. We swooped down low over the Holy City, which is spread over several hills, and suddenly the Great Mosque was right under us. In its centre stood the *Kaaba,* the Moslem's holy shrine : to me it looked like a rectangular building about 50 ft. high and painted black. Later in Mecca I found that what I saw was merely a black cloth on a framework covering the two-feet long meteoric stone which has been kissed every year for the last 1,317 years, ever since 632 A. D., when Mohammed made his

Aircraft from all over the world land their loads of pilgrims at Mecca's airport. Picture shows an Egyptian (right) and an Indian machine.

A pilgrim wearing an *Ihram,* the ceremonial garb, descends the second ladder placed against the DC-4's exit. The first broke. The Braathens SAFE airliner was the most modern ever to have landed at Jedda.



Aircraft from all over the world land at Mecca's airport. This Fiat G-12 belongs to Egypt's S.A.I.D.E. Arab officials are lining up for a very strict passport inspection — just as in Europe, only more so.

historic pilgrimage to the City. The Mosque was thronged with thousands of white-clad people, who all watched us passing over them on our modern flying carpet.

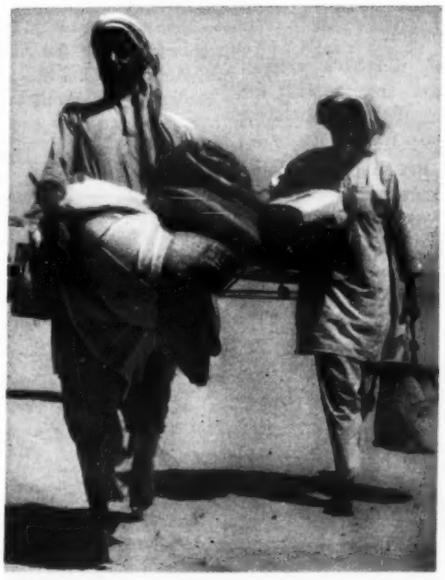
We continued out to Mecca's airfield at Jedda, which in turn is the seaport of the Holy City. The field was so crowded with aircraft standing and taxiing about in gay abandon that we went on right out over the Red Sea to give them time to get sorted out. The Red Sea, incidentally, is not red at all but blue as the Mediterranean at Juan-les-Pins. Perspiration was running down us like heavy rain until the aircraft had gained some height ; we turned and dived down again into the fierce heat. We came in close over the snow-white houses of Jedda, caught a glimpse of the harbour filled with ships of every description disgorging pilgrims. In an enormous dust-cloud we finally landed on the uneven field. Red carpets were quickly laid out from the DC-4 to the point where a crowd of dignitaries were waiting for our distinguished passengers.

It is the dearest wish of every pilgrim to die after he has seen Mecca. With the Braathens' aircraft and its trained crew the chance of doing so was small, but an opportunity arose immediately after we had landed. The ladder which was brought to our door was the most primitive and fragile thing in the world, and the first two pilgrims promptly fell when the rungs broke. I, as number three, climbed down half the way and fell the rest. After nine-and-a-half hours of non-stop flying I was at last in Mecca, to be received by policemen and passport inspectors. They cleared me promptly when they saw my impressive visa. When I showed them the letter I was carrying, they saluted me like a Bedouin chief and took me to a handsome man whom they saluted like a king. He was Prince Mohammed Beyk Abdul, the man to whom my letter was addressed and a close friend of old King Ibn Saud. He thanked me in excellent English.

Meanwhile I found that the captain of our DC-4 had got into serious trouble. Only very few of the forty pilgrims were able to pay 46 pounds Sterling for their landing fee. When the police tried to round them up after an hour's discussion with the crew, they had all fled to the sweltering hotels and caravanserais of Mecca, and it was the captain who had to fork up in cash the huge amount of money in order to get permission to take off again. The dispute was as blazing hot as the burning sands, but the Arabs remained adamant and refused to issue the starting permit before the money was paid.

Immediately after this was done the happy crew rushed to their aircraft and got ready for their return trip to cool Norway. Somewhat melancholically I watched them vanish over the Red Sea.

Portable beds and buckets of water are carried from the aircraft by these pilgrims.



Here was I, alone, a white man, burdened with the task of making preparations for the night. But that is another story. I finally went to Mecca and inspected the strange and wonderful town.

My trip back to Tehran was arranged aboard an old Dakota. It was the bumpiest trip I ever made. There were only four of us, two pilots, a wireless operator and myself, plus a number of sandbags, and we were thrown around in the atmosphere like a ping-pong ball in a hurricane. Sometimes the aircraft dropped so rapidly that our water-cans other belongings flew right up to the roof. We had to climb to 18,000 ft. to clear the peaks—in a pitch black night and without oxygen equipment. There were no radio beacons or other navigation aids, but we *did* have a marvellous French pilot at the controls. More than eleven hours after taking off, we landed at some place enveloped in absolute darkness—and discovered it to be the airport of Tehran.

I am now a *Haddji,* the title given to a man who has been in Mecca. Yes, it was a fantastic journey. The best of it was, perhaps, that nobody in Tehran would believe that my passport could be stamped in Mecca the same day as my arrival back in Tehran. That was beyond the comprehension of the Persian police, who until this day maintain that a trip to Mecca takes anything from six to eight months. Upon my arrival, some over-zealous police first tried to arrest me but finally contended themselves with seizing my passport. It took me three weeks of verbal fighting and a visit to the Ministry of Justice to get that freakish document back.

Personalities

AIR TRANSPORT

I.C.A.O. : Dr. Edward P. Warner, President of the I.C.A.O. Council, has been awarded the Daniel Guggenheim Medal and Certificate for 1950 for "pioneering in research and a continuous record of contribution to the art and science of aeronautics."

Lieutenant-Colonel Jean Verhaegen, of Belgium, has been elected First Vice-President of the I.C.A.O. Council for a one-year term; *Dr. K.N.E. Bradfield,* Australia, Second Vice-President ; *Commodore D.A.F. Grassi,* Argentina, Third Vice-President ; *Brigadier C.S. Booth,* Canada, Chairman of the Air Transport Committee ; *Rear Admiral Paul A. Smith,* U.S.A., Chairman of the Committee on Joint Support of Air Navigation Facilities. — *M. Tippett* has been appointed I.C.A.O. Representative for South America, with headquarters in Lima, Peru.

I.A.T.A. : Warren Lee Pierson, Chairman of T.W.A., has been elected President of I.A.T.A. for the 1950-51 fiscal year ; Juan T. Trippe of P.A.A. was originally slated for election but U.S. airline operators objected. *Dr. Albert A. Plesman,* President-Director of K.L.M., at the same time assumed office as I.A.T.A. President for 1949-50. This event coincided with his sixtieth birthday, the thirtieth anniversary of K.L.M. and the thirtieth birthday of I.A.T.A.

Dr. Edward P. Warner

Lieutenant-Colonel Jean N. Verhaegen

Brigadier C. S. Booth

Rear-Admiral Paul A. Smith

U.S. Government : Thomas S.W. Davis was sworn in as Assistant Secretary of Commerce in charge of aviation matters October 14th. He succeeds John R. Allison, who resigned April 1st.

Bulgarian Government : Georgi Tchankov has been appointed Minister of Transport, succeeding Stefan Tomchev. The latter, together with his Deputy, M. Markov, had been dismissed for incompetence.

British Government : C.J. Lewin has been appointed Civil Air Attaché to the Central American and Caribbean Republics, with headquarters in Jamaica. He is succeeded as Civil Air Attaché in the Middle East by *R.M.S. Ryner,* hitherto Assistant Civil Air Attaché.

British European Airways Corporation : Peter G. Masefield has been promoted Chief Executive of B.E.A.C., in succession to J.V. Wood, who resigned some weeks ago.

British Overseas Airways Corp. : J.W. Booth, formerly Chairman of the now merged B.S.A.A.C., has assumed office as Joint Deputy Chairman of B.O.A.C. with Whitney Willard Straight.

K.L.M. Royal Dutch Airlines : Ivan Smirnov, K.L.M.'s veteran "mileage millionaire," has resigned after 27 years' service with the company. Seems he couldn't get accustomed to the administrative job he took up a few weeks ago.

Ceskoslovenske Aerolinie : Leopold Thurner, 40, has been appointed Director-General of the Czech national airline in succession to General Alois Kubita, who has been pensioned.

Braathens S.A.F.E. : Major E. Ulleberg-Johansen has joined this large Norwegian regular and charter carrier as Operations Manager ; he formerly was Deputy Operations Manager for D.N.L., Norway's national airline.

Warren Lee Pierson

Dr. Albert Plesman

Ivan Smirnov

Leopold Thurner

Major E. Ulleberg-Johansen

Robert Gavin McCoy

Roy T. Hurley

C. C. Pearson

Central African Airways Corp. : Robert Gavin McCoy has assumed office as General Manager. Previously he held the job of B.O.A.C. Station Manager at Johannesburg.

INDUSTRY

Curtiss-Wright Corporation (U.S.A.) : Roy T. Hurley, former top production expert for Ford Motor Co., is the company's new President.

Glenn L. Martin Co. (U.S.A.) : Glenn L. Martin has been elected Chairman of the Board. The company's new President and General Manager is *C.C. Pearson,* former Curtiss-Wright Vice-President. Resigned have Vice-Presidents H.T. Rowland and Morgan R. Schermerhorn. —New Chief Engineer is *William D. Bergen,* hitherto Director of Special Weapons Department.

McDonnell Aircraft Corp. (U.S.A.) : D.R. Berlin has been named Executive Vice-President, C. Warren Drake Vice-President (Manufacturing).

Fairchild Engine & Airplane Corp. Nuclear Energy for the Propulsion of Aircraft (NEPA) Division (U.S.A.) : *Andrew Kalitinsky* has been awarded the Manly Memorial Medal for his research work.

National Advisory Committee for Aeronautics (U.S.A.) : Abe Silverstein has been promoted Chief of Research at N.A.C.A.'s Lewis Flight Propulsion Laboratory, in succession to *Addison M. Rothrock,* the new Assistant Director for Aeronautical Research at N.A.C.A. headquarters in Washington.

William B. Bergen

D. R. Berlin

Andrew Kalitinsky

Maurice Roy

Office National d'Etudes et de Recherches Aéronautiques (France) : Maurice Roy of the Academy of Sciences, has been appointed Director-General of ONERA, France's central aeronautical research institute, replacing M. Evalley.

Svenska Aeroplan A.B. (Sweden) : Lars Brising has been promoted Chief Engineer of Design and Development.

Alvis Ltd. (G.B.) : J.J. Parkes has been elected Chairman of the Board in addition to his appointment of Managing Director. *R.W. Rutledge* has been named Deputy Chairman and Financial Director.

Westland Aircraft Ltd. (G.B.) : E.C. Wheeldon will assume office as Managing Director on March 31st, 1950, in succession to John Fearn ; the latter will remain on the Board of Directors.

Lars Brising

J. J. Parkes

PROFILE OF THE MONTH :

Fritz Zwicky

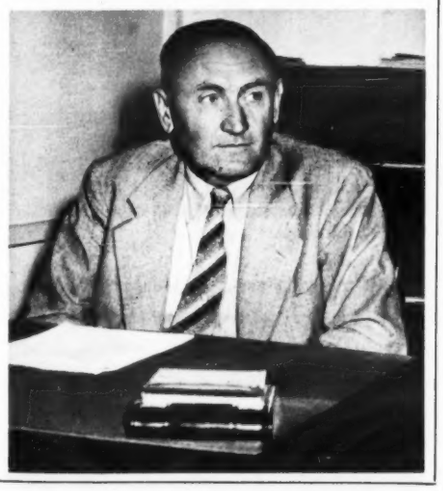
To Dr. Fritz Zwicky, noted Swiss astronomer and physicist, astrophysicist at California Institute of Technology and a co-founder of the Aerojet rocket research project (now Aerojet Engineering Corp. of Azusa, Cal.), the U.S. Freedom Medal was awarded September 21st. The award was made at an exclusive luncheon in Pasadena's Hotel Huntington by Dan Kimball, U.S. Under-Secretary of the Navy and former manager of Aerojet.

A citation read by Brig. Gen. Thomas Chapman, chief of Air Materiel Command's Los Angeles Air Force Procurement Field Office, declared as "outstanding" Dr. Zwicky's service in obtaining details of German rocket research and recommending the basic structure for present United States rocket research and development programmes.

Recognition of Dr. Zwicky's wartime research for the U.S. Government discloses only a single facet of the Swiss scientist's career.

Primarily a physicist, Dr. Zwicky's early career in America was jeopardized when he explosively challenged as inefficient the sky charting techniques of leading accredited astronomers of Mt. Wilson Observatory. To prove his point he all but abandoned his physics activity at California Institute of Technology and transformed himself, almost overnight, into an astronomer. Making first use of the revolutionary Schmidt telescope, Dr. Zwicky isolated himself on Mt. Palomar and in a short space of time discovered more *super-novae* (exploding stars) than had ever been catalogued in the entire history of astronomy. His observations led him to be one of the first to advance the theory of nuclear chain reaction.

During World War II, established as discoverer of the technique now accepted for mapping of the heavens, Dr. Zwicky did another about-face and plunged into military rocket research and projection of other reaction power plants. His secret forecast of the pulsejet reaction engine was scoffed by fellow U.S. scientists up to the day Germany's first pulsejet "buzz bomb" struck England. Dr. Zwicky's subsequent development of a morphological chart of reaction power units, suggesting more than 300 types of reaction engine, is a provocative guide to fantastic power plants. After the close of World War II the scientist proposed the use of shaped charges of explosive to hurl metal slugs at meteor speeds from the nose of a V-2 rocket as a means of extending upper atmosphere studies by spectroscopic analysis of the incandescent trails of the "artificial meteors." The initial test of this project apparently failed, and subsequent tests, if any, have not been disclosed.



International Brass

COOPERATION . . .

Atlantic Pact :

A Joint High Command to control the defence machinery of the twelve Atlantic Pact nations was formed October 6th. It consists of *General Omar N. Bradley,* Chairman of the U.S. Joint Chiefs of Staff ; *General Paul Ely,* Chief of Staff of the French Air Force ; and *General Sir William Morgan,* Chairman of the British Joint Services Mission in Washington.

General Lechères, of the French Air Force, Chairman of the French Chiefs of Staff Committee, has been appointed French Representative on the Atlantic Pact Committee.

L. to r. : General Morgan, General Bradley, General Ely

AIR FORCE

Royal Air Force :

Marshal of the Royal Air Force Lord Tedder, Chief of Air Staff, who is 59 and looks 49, will retire on January 1st, 1950, to "make room for younger men." He will be succeeded by *Air Chief Marshal Sir John Slessor,* 52, now Commandant of the Imperial Defence College.

Air Marshal Sir Leslie N. Hollinghurst, Inspector-General of the R.A.F., and *Air Marshal Sir Hugh W. L. Saunders,* Air Council Member for Personnel, exchanged appointments October 31st.

Air Vice-Marshal Thomas Arthur Warne Browne on October 15th assumed the appointment of Air Officer Commanding-in-Chief, Maintenance Command, with the Acting Rank of Air Marshal.

Air Commodore H. I. Cozens has been appointed Director of Plans under the R.A.F.'s Assistant Chief of Air Staff for Policy.

Air Commodore A. M. Charlesworth, of the Royal Australian Air Force, has taken up duty as Chief of Staff to the Commander-in-Chief of the British Commonwealth Occupation Forces in Japan.

Lieut.-General Craig

Lieut.-General Chidlaw

U.S. Air Force :

A new *Inspector-General* of the U.S.A.F. has been appointed in the person of *Lieutenant-General Howard A. Craig.*

In the *Air Staff, Major-General Kenneth B. Wolfe* has assumed the functions of Deputy Chief of Staff for Materiel ; on this occasion he was promoted to Lieutenant-General.

Air Materiel Command : Lieutenant-General Benjamin W. Chidlaw is the new Commanding General. *Major-General St. Clair Streett* is Deputy Commanding General ; *Major-General Orval R. Cook,* Director of Procurement and Industrial Mobilization ; *Major-General Frederick M. Hopkins, Jr.,* Deputy Chief of Staff (Operations) ; *Major-General Franklin O. Carroll,* Assistant to the Deputy Chief of Staff (Materiel) ; *Major-General Samuel R. Brentnall,* Director of Research and Development ; *Brigadier-General Alfred H. Johnson,* Chief of the Industrial Mobilization Planning Division ; *Brigadier-General Swofford,* Chief of the Engineering Division.

Ninth Air Force : Major General Willis H. Hale, formerly U.S.A.F. Caribbean Air Commander, has taken over command.

Caribbean Air Command : The new Commanding General is *Brigadier-General Rosenham Beam.*

U.S. Munitions Board : U.S.A.F. Major General Patrick W. Timberlake, formerly Deputy Director, to be Director in place of Army *Lieutenant-General L. Lutes.*

Lieutenant-General Barton K. Yount, Chief of U.S.A.F. Training Command during World War II, has died at the age of 64.

Peruvian Air Force :

Major Abdon Caballero has been appointed Commander of the Peruvian Air Force.

French Air Force :

Brigadier-General Marcel Joseph Vigouroux has been appointed Commanding General of Air Transport Command.

Brigadier-General Edmond Jules René Jourhaud has taken over Command of the Technical Training School.

General Lechères

Lord Tedder

Air Chief Marshal Sir John Slessor

Italian Air Force :

Lieutenant-Colonel Elbano Chiglia is the new Chief of the Press Section and of the Air Department of the Ministry of Defence.

Soviet Air Force :

Major-General Anatoli Lapidevski, of the Air Force, first pilot to be named a "Hero of the Soviet Union," is Deputy Minister of Aircraft Production.

ARMY

U.S. Army :

General Joseph Lawton Collins has been appointed Army Chief of Staff in succession to General Omar N. Bradley, first Chairman of the Joint Chiefs of Staff.

Brazilian Army :

General Floriano de Lima Brayner, Brazilian Military Attaché in Paris, has been awarded the American Legion of Merit in recognition of his wartime services.

NAVY

U.S. Navy :

Rear-Admiral Thomas L. Sprague, former Chief of Naval Personnel, has been appointed Commander of the U.S. Pacific Fleet Air Arm, in succession to Vice-Admiral Harold B. Salada, who is retiring.

Royal Navy :

Rear-Admiral M. J. Mansergh last month took office as Fifth Sea Lord and Deputy Chief of Naval Staff (Air). *Vice-Admiral Sir Charles S. Daniel* has succeeded Air Chief Marshal Sir John C. Slessor, Chief of Air Staff-designate, as Commandant of the Imperial Defence College.

Major-General Hale

Brigadier-General Beam

Lieutenant-Colonel Elbano Chiglia

Rear-Admiral Sprague

Rear-Admiral Mansergh

Motorless Flight

The Wandering Mountain—Sailplane Pilots' Paradise

BY W. JUCKER, ZURICH

One of our recent articles, entitled "Date with a Cloud," told of the hopes a group of U.S. soaring pilots have in the occurrence of standing atmospheric waves at the lee slopes of California's mountain ranges : by flying from one to another of the lenticular clouds characterising the crests of these waves, it should be possible to accomplish high-altitude soaring flights across large expanses of the American Continent. But do such clouds always wait to be "dated" at the spot where they arise? Below, a Swiss sailplane pilot tells of his observations of such a cloud which did* not *wait, and of the no less attractive prospects this phenomenon, which he calls the "wandering mountain," offers to soaring enthusiasts.* — Ed.

Strong cumulus storms extended to the tropopause before we took off, lifting the overlying air layers.

Over the Lake of Zurich a turbulent layer made itself felt as strong gusts on our wings.

On the horizon we perceived a cascade-type wall of clouds...

Frequent cloud observations, as part of a series of systematic investigations of atmospheric waves, drew our attention to a phenomenon offering intriguing prospects to sailplane pilots. We discovered that the Foehn waves which greatly assist high-altitude soaring flights, do not simply disintegrate at the northern foot of the Alps, but suddenly wander away at high speed, without losing any essential amount of their general structural features. In point of fact, this occurrence has been the cause of many abortive flights, for the waves often departed before the aeroplane-sailplane tow combination could reach the desired spot.

A second observation gave birth to the idea of the research flight described here. In our atmospheric wave theory, on which we are currently working, we attribute atmospheric oscillations to the vertical movements causes by obstacles, whereby the obstacles may be either orographical or atmospherical in nature. In addition to many other research results, we owe this conclusion to observations of oscillatory processes over cold fronts. Thus we no longer share the opinion that the surface of air masses exercises a decisive influence on several types of wave. Notably in the case of cold masses, the surface does not appear to be regular and should not, therefore, disturb the structure of overlying air masses. In reality, a sailplane pilot can ask for nothing better than such surface oscillations over a cold front, as not only can he use cloud-free up-wind zones to gain altitude but he can also cover eventually considerable distances.

The first research flight by "wandering mountain"

The thoughts occurred to Eugen Aeberli and myself during a flight we made in a Piper "Grasshopper" on January 12th, 1948, from Zurich's Dubendorf airfield. Already during the preceding month of December, whilst carrying out a flight in this well-equipped aircraft for our soaring research group, "Segelflugforschung Alp Scheidegg," we had investigated a low-altitude wave over the Lake of Zurich, and our aim now was to repeat the flight under the same weather conditions. Prior to taking off, moreover, we spotted very favourable undulant clouds, reaching a considerable altitude. As usual, we had precise information from our weather charts : a small cold front, then situated to the west over the Jura Mountains, was approaching our zone. We were able to observe fair-weather cumuli preceding this front, whilst a large cumulo-nimbus was visible in the east, over the Säntis, to which the Foehn wind had given the shape of a layered undulant cloud, reaching to about 10,000 metres above sea level. I was more interested in investigating the vertical currents over the cold front than approaching this cloud which might not last very long. I was

* INTERAVIA, Review of World Aviation, Vol. IV, Nr. 4, pp. 211-215.

mainly interested in finding out whether the air masses underwent oscillations when gliding over the cold mass.

At 1 : 15 p.m. we took off into a southwest wind, which soon became stronger over the Zurichberg, forming turbulence which made itself evident as gusts hitting our wings. After we had climbed to 2,300 metres and therefore topped the cumulus layer, we perceived on the clouds the aircraft's shadow surrounded by two multi-coloured rings. After a few cross-flights, but always over Zurich, the temperature suddenly dropped at 2,600 metres. Though the sun was shining more intensively, our feet noticed the fall in temperature. At this altitude I spotted an alto-stratus layer to the southwest, which looked exactly like a Foehn wall. After a short while a cloud detached itself from this cloud cascade formation, and moved towards us. We immediately decided to fly towards this cloud, as it interested us from the soaring standpoint. Its shadow continued to grow on the almost compact cumulus layer beneath us. As we could not tell whether it was an ice cloud or a sub-cooled water cloud, we preferred to fly beneath it rather than risk getting iced up. Had we guessed correctly—would we find up-winds on the windward side ? We were pretty excited. Then it came ! Scarcely had Aeberli curved into the windward side before our aircraft, with engine throttled, began climbing—not at half a metre but on the average one metre a second, sometimes even two and a half. As if on a wandering mountain we were "slope soaring" on a steady up-wind. Along the whole length of this "cloud range" we found the same up-wind, enabling us to climb well above the cloud and gain a total of 700 metres. At 3,750 metres above sea level we stopped climbing as the up-wind had weakened. However, we had covered several kilometres thanks to this cloud. We interrupted our flight here, "killed" our altitude with steep spirals, and returned to base.

Result of the research flight

Though I had frequently observed moving undulant clouds I had previously never heard of any flight made with the help of a moving wave. (Kronfeld's long distance flight in 1931, when regularly occurring vertical currents were reported, may have been due to some other reason.)

Briefly summarized, our flight yielded the following data :

1. After climbing at an average of less than 0.5 m./sec. in a light two-seat aeroplane, we suddenly began climbing at over 1.0 m./sec. on the same engine r.p.m.
2. The up-wind zone was on the windward side of an undulant cloud of some 200 metres thickness.
3. The up-wind was steady.
4. The up-wind zone extended along the entire width of the cloud's windward side and topped it by about 500 metres.
5. The cloud and the up-wind zone travelled with the wind at about 50 kms./hr.
6. The vertical current had no direct connection with the air layers in ground vicinity.

It follows from these data that this particular vertical current at over 3,000 metres above sea level involved an oscillatory type of motion. It is therefore easy for sailplane pilots to take advantage of this phenomenon for long-distance flights over clouds. Nevertheless, the moving wave has also disadvantages—at least for the time being, until we learn more about the occurrence of such up-winds. As we can deduce no connection with up-winds in ground vicinity, it requires a practiced eye to recognize such up-wind zones. Having oneself towed to the spot is long and expensive.

On the other hand, our research flight proves that moving waves with sufficient up-wind really do occur. It also seems to confirm our assumption that the high-altitude Foehn waves do not alter essentially when they move. Long-distance flights at great altitude are therefore not only possible for sailplane pilots, but go so far as to confront soaring with a plethora of attractions for the future.

. . . which pushed off an undulant cloud with the wind towards us, like a glacier releasing an iceberg.

We waited above Zurich at about 3,000 metres for the undulant cloud whose shadow, visible on the cloud layer beneath us, indicated how it was moving.

We climbed at an average of more than one metre per second over the windward side of the "wandering mountain."

Book Reviews

Les Amériques et l'Empire des Airs, by Henry Mourer. Les Editions Internationales, Paris, 1949.

André Siegfried, Member of the Académie Française, says in the introduction to this book : "The subject of this book is extremely topical, for it embraces the two most revolutionary changes taking place during our lives—the entry of the American continent into the fight for world supremacy, and the dawning of the air age. The New World is on the point of taking over the leadership of our planet, whereby the international links by air play a decisive rôle. The present book contributes significantly towards a better knowledge of our world and our era. I warmly recommend it . . ."

It is hardly possible to describe the matter more clearly. Pax Americana and Air Age are inseparable concepts. It is no coincidence that the two largest organisations for world aviation, ICAO and IATA, have their headquarters on the North American continent ; that the stipulations of the U.S. Civil Aeronautics Board and Civil Aeronautics Administration are respected by all countries, almost as though they were national institutions. And yet, general knowledge is amazingly scanty as regards the history and aviation policies of the Americas. Those who read Henry Mourer's book will understand why our school atlases are obsolete, why we must revise our concepts of geography, history, transport policies and strategy. (French.) *He.*

Le Pilotage des Avions, by G. Coutaud and Y. Teissier (No. 348).
Les Transports Aériens, by M. Gautier and J. Marais (No. 359).
Le Matériel Volant, by P. Lefort (No. 362).
La Propulsion des Avions, by G. Lehr (No. 364).
Collection "Que sais-je ?" — Presses Universitaires de France, Paris, 1949. (All in French.)

Filled with righteous indignation about a number of printing and other errors in *Les Transports Aériens,* which figure in annoying prominence on the page containing data on the cruising speed and range of commercial transport aircraft, our beloved air hostess, Esmeralda, made precisely these figures the victims of her feminine scorn in the August issue of our magazine. But our technical editors, who had to struggle with similar figures last year, find that, with the best will in the world, they could not have given data very different from those listed by the authors of this small book. All the same, our editors know that performance guarantees have to be taken with a pinch of salt—in the shape of a two to five per cent. tolerance—and that the co-pilot will under no circumstance open the throttle to max. cruise speed while the captain is flashing on the "Fasten Seat Belts" sign. The authors of this book could easily have made those points somewhat clearer. But Esmeralda, with Eve-ish venom, complains that our editors should also have done this—and thereby she has the last word. But back to the book. In very few pages it deals with all the aspects of air transport operations and economics, systematically and, in most cases, with commendable care. On the other hand, however, there is a paucity of practical examples and of clarity, which may render the booklet too dry for the wider section of the public. Nevertheless, it could serve as an excellent repetition text book for training "junior" airline personnel, who are frequently so overfed with clear texts that they have difficulty in assessing their own knowledge.—*Le Pilotage des Avions,* before coming to the practical piloting of aircraft, deals with such theoretical aspects as the mechanics of flight, aircraft stability, controls and instruments.—*Le Matériel Volant* presents a clear and systematic survey of the different kinds of powered aircraft, their fields of application, and a list of the chief French, British and American types.—*La Propulsion des Avions* begins with the reciprocating engines, explaining their method of function (combustion, fuels, mixtures, etc.) and their various component parts. Subsequently, in a much shorter way, the gas turbine and its auxiliaries are dealt with ; then the propeller, and the fundamental principles of jet propulsion. *T.*

Wind-Tunnel Testing, by Alan Pope. — John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., London, 1947.

The author has set himself the task of elucidating, in comprehensive form, the main problems involved in the construction and practical application of wind tunnels. The first chapter, concerned with the various types of wind tunnel in use today, is followed by detailed explanations of wind-tunnel measuring techniques. This section will be of value primarily to engineers concerned with wind tunnels. Also, the measuring methods currently used for studying helicopter rotors and aircraft models with simulated jet propulsion, are dealt with here. Several pages are devoted to the questions of wind-tunnel corrections, notably as regards measurements under conditions of high subsonic speeds. Mention should also be made of a commendably complete table of data on existing wind tunnels as well as of the bibliographical notes forming the conclusion to each chapter. *Ba.*

Anwendungen der elektrolytischen Methode auf die Betz'sche Theorie der Spaltverluste an Schaufelgittern, by Dr. Mahmoud Ali Hassan. — Report No. 15 of the Aerodynamics Institute, Swiss Federal College of Technology, Zurich. Published by Verlag Leemann, Zurich, 1949.

The problem of slot losses in turbine blade cascades was first worked out by Betz. The present booklet, representing the author's doctor dissertation, shows how Hassan applied the principle of electrolytical analogy to this field, how he was able to confirm Betz's results and, moreover, to develop them still further. (Betz's results are based on simplified assumptions and apply primarily to larger slots between the rotating and stationary parts of turbo machines.) To check the reliability of the electrolytical method, several investigations were made electrolytically and mathematically. (German.) *Ba.*

Cours d'Aérotechnique, by G. Serane. — Dunod, Paris, 1949.

Mr. Serane's book provides profitable reading for all who wish to acquire a general but nonetheless thorough knowledge of aeronautical engineering. Although certain basic principles of mathematics should be known in advance, if the reader is to understand the entire book, the course is written in such simple and clear language as to render it understandable to the non-specialist. It begins with the classical fundamentals of hydrodynamics and aerodynamics (Bernoulli, Reynolds, standard atmosphere, and so forth), continues with the drag of simple bodies and theory of wings, examines different structural methods, engine types and the laws of flight mechanics, deals with stability problems and flight performance data, and ends with discussions on flying-boats and a number of aircraft instruments. (French.) *Rb.*

Les Aides à la Navigation aérienne. Published by the Institut Français du Transport Aérien, Paris, 1948.

Printed in manuscript form, this very thoroughly compiled survey of all existing procedures for radio navigation, instrument landing and traffic control is intentionally limited, in the technical descriptions of the individual methods and equipment, to a generally understandable minimum, but compensates for this by judging their ability, which is examined in detail through practical examples from the most interesting areas for European aviation—on the one hand, Western Europe and the Mediterranean region ; on the other hand, the North Atlantic. Enhanced by numerous good diagrams and plenty of index material, this book is warmly recommended as an introductory work for all who wish to obtain a general idea of the subject before tackling special problems of radio navigation. (French.) *Ri.*

Le Radar (Radio Detecting and Ranging), by R. Faure. Gauthier-Villars, Paris, 1948.

The reader need have only a general knowledge of the principles of electricity to understand the author's explanations of the functions of radar, the selection of suitable wavelengths, the method of oscillation production, and finally the basic principles of radar navigation (chiefly as applied to marine navigation). Since the booklet comprises only forty-five pages, it naturally cannot offer more than a rapid survey for the benefit of those who, within a few minutes, wish to add this new subject to their store of knowledge. (French.) *Rb.*

Wireless for Beginners, by C. L. Bolz. — George G. Harrap & Co. Ltd., London, 1949.

Mr. Bolz deserves praise for a popular science book which, requiring no technical or mathematical knowledge on the reader's part, is fascinating, accurate, and "grown-up" in style : the principles of radio are smoothly introduced from their natural beginning in electricity and magnetism, the many diagrams are drawn according to the accepted method, electrons are atomic particles and not hobgoblins. It ends with a few words on television, radar, and some useful appendices. The book may consequently be appreciated by those interested in aviation radio, though it is written chiefly for possessors of a home radio or television set. *Sa.*

Must We Hide? by R. E. Lapp. — Addison-Wesley, Cambridge, Mass., 1949.

The title of this book immediately betrays the fact that it is concerned with the atomic bomb. And along with the atomic weapons, atomic literature is beginning to get on contemporary nerves. Even though Dr. Lapp worked on the atomic bomb project from its earliest days and was a member of the Manhattan Project, later becoming Executive Director of the Committee on Atomic Energy of the National Military Establishment's Research and Development Board ; even though he was present at both atomic bomb explosions at Bikini as scientist consultant and may consequently be regarded as an all-round expert on nuclear fission and its terrible effects . . . our contemporaries are tired of the subject and loth to concern themselves with the atomic bomb. Only, the rub is that the atomic bomb is very much ready to concern itself with humanity. So that it is all the same advisable to read this book. The reader will find in it neither complicated formulae nor bloodthirsty sensation, but the answers to many important questions on the bomb's effects and possible defence measures, in simple, understandable language. *He.*

Der letzte Monat, by Karl Koller. — Norbert Wohlgemuth, Mannheim, 1949.

In this collection of extracts from his diary the author, former chief of the Luftwaffe General Staff, evokes the Führer's bunker in his description of the Third Reich's last month. Luftwaffe Supreme Command, OKW, Karinhall, Berchtesgaden, General Jodl, Himmler, Kaltenbrunner, Hanna Reitsch . . . we all know this *dramatis personae ;* and we all are thoroughly fed up with it ! That account has been settled, the world now wants peace. Nevertheless, all these memoirs, scraps of conversation, shorthand notes, orders of the day, etc., will acquire historical value. Carefully examined, they will reveal to how great an extent Germany's power, even her air power, was fantasy. (German.) *He.*

Transport and Communications Review (Revue des transports et des communications). — Quarterly published by the Transport and Communications Division, Department of Economic Affairs, United Nations, Lake Success, New York. (Separate English and French editions.)

This journal, now in its second year of publication, provides a useful supplement to the ICAO publications. It contains studies made by the United Nations Organization on the transport and communications conditions prevailing in specific regions (whereby appropriate attention is devoted to air transport), on international transport questions, and on the activities of the specialised agencies working together and with UNO, the most important of which is ICAO. A survey of world transport and communications, consisting of excerpts from trade journals, and an international calendar of events form the conclusion to the magazine. *T.*

DC-3, Super DC-3, Mamba DC-3...

There are some aircraft types which refuse to grow old! Just like celebrated dancers, they haven't the heart to leave the stage where they gained their fame. For example, the old German Junkers Ju 52 transport, which dates back to 1932, is still flying today. Granted, no beauty treatment can remove the wrinkles from this "airline grand-mother's" corrugated skin; and it is gradually disappearing as the very last spare parts are being used up.

Meanwhile, the Douglas DC-3, born in 1935 at Santa Monica in Californian sunlight, displays considerably more vitality. Even during its youthful years it was a celebrated beauty, and was soon bought by seven American, four European and one Australian airline company. Its seating capacity—21 passengers and even 28 passengers—caused excitement in those days and promised many economic advantages. By the end of 1937 the Douglas Aircraft Company had received orders for, and delivered the greater part of, 150 such aircraft—an unparalleled success.

When war broke out, the DC-3 was put into uniform. As a military transport, under the code designations C-47, C-49, C-53 and popular names "Dakota," "Skytrain," "Skytrooper," it flew on all fronts, over the "Hump" in Burma's airlift, carrying paratroops, soldiers, combat materials, foodstuffs, animals, evacuated civilians and wounded. By the end of the war America had built over 10,000 units—a record figure—delivering them not only to U.S. air transport units but also to Allied countries. Even Soviet Russia received several hundred C-47s and, moreover, later fitted the type with Russian radial engines and produced it under the designation Li-2.

The DC-3 never stopped improving its performance. Superior engines—Pratt & Whitney "Twin Wasps" and Wright "Cyclones" —finally yielded a 20 per cent. better take-off power and an increase in the permissible military take-off weight, from an original 24,000 to 31,000 lbs. More efficient propellers, better engine cowlings, and so forth, gave it improved speed and climbing performance. Modern radio-navigation aids and automatic-pilot equipment replaced the obsolete pre-war instruments.

How successfully the C-47 fulfilled the tough requirements of ruthless war operations is evident from the fact that, after the war, the U.S. War Assets Administration offered some 4,000 of these transports for sale as surplus equipment, and was able to sell them on the spot. The U.S. military nevertheless retained a good number, and it is not so long ago that this "workhorse of the air" was able to prove its worth anew—on the Berlin Airlift. Those sold as "surplus" have since taken to the air again, either under foreign military designations or as passenger and cargo transports flown by countless scheduled and non-scheduled airlines companies the world over. Alone the seventy IATA-member airlines are at present operating over 900 re-converted DC-3s.

In addition to Douglas, several U.S. and four European firms undertook such re-conversion work. The latter comprised the Dutch Fokker concern, which had gathered experience from assembling and repairing DC-3s before the war; Scottish Aviation Ltd., of Prestwick; the Belgian SABCA concern, and Fiat's Turin factory. The majority of " re-civilised" DC-3s were equipped with 21 seats, though certain models were fitted to accommodate 24, 28 or even 32 passengers.

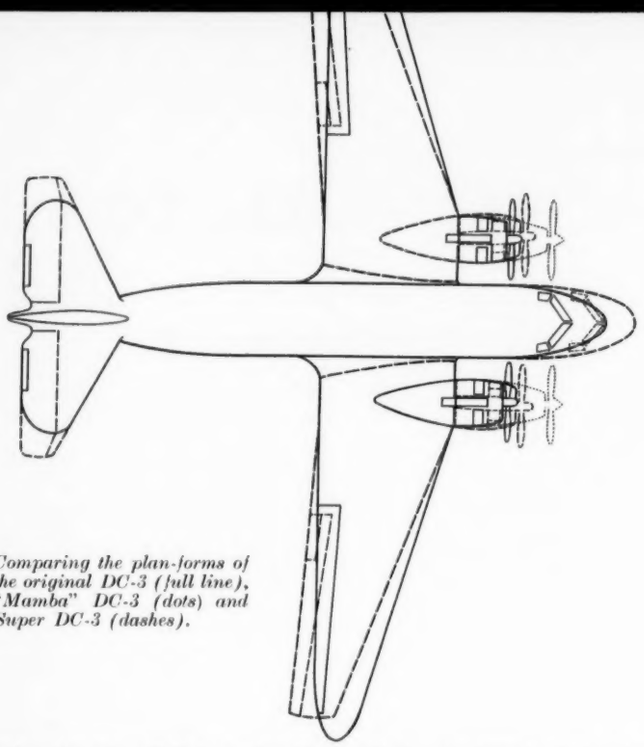
In this way the airlines received their first suitable post-war, medium-range equipment that was immediately ready for service —and at reasonable prices. The only hitch concerned the DC-3's maximum permissible take-off weight for civil operations. A dilemma involving economics and take-off safety, it was difficult to find a solution satisfactory to all parties. The 31,000 lbs. allowed for the military transport version was clearly unacceptable for civil operations. Climbing performance after take-off, performance on one engine and design level flight speed were too restricted at this high loading. Meanwhile, Great Britain and Holland saw no adequate reason to go below 28,000 lbs. for well maintained aircraft taking off from first-class runways, whilst the U.S.A., Scandinavian countries and Switzerland wanted to play safer and set the highest civil take-off weight at 25,200 lbs. Understandably, these countries did not like the idea of foreign competitors leaving their airfields with higher loads. France and Australia took the middle way and decided on 26,200 lbs. And it is only very recently (March, 1949) that the competent agency in such matters, ICAO, decided on a semi-standardized solution. It was proposed to all member countries that, until international standards were made valid, the weight limits for DC-3s be set by the countries of registry; however, countries whose territory is entered or flown over could require that this weight be limited to 26,200 lbs.

That difficulty, therefore, has been circumvented. But a new and increasingly threatening one has since arisen. On September 1st, 1949, ICAO's airworthiness standards for Transport Category A aeroplanes became effective. For such aircraft there now exist stricter operating limitations, on which the member countries were allowed to voice their opinions up to July 15th last. And these limitations are especially strict with respect to twin-engined types. Although it is by no means definite that Transport Category A standards will soon become a premise to certification for all civil airliners, aircraft and airline firms already now attach great value to meeting them. The most important decision is to be found in Annex 6 (Standards and Recommended Practices) to the Convention on International Civil Aviation, and reads as follows :

4.2.2.4. *Take-off flight path.* A flight shall not be commenced

The old DC-3, known the world over, has rounded wing tips, semi-retractable main landing wheels, a fixed tail-wheel.

The Super DC-3's wing has rectangular tips, more sweep-back; the main wheels retract completely; the tailplane is considerably larger.



Comparing the plan-forms of the original DC-3 (full line), "Mamba" DC-3 (dots) and Super DC-3 (dashes).

unless the take-off flight path *with the critical engine becoming inoperative* at the critical point... indicates that the aeroplane :

a) can attain a height of 50 feet before passing over the end of the take-off strip or channel;

b) while within the aerodrome boundary, can clear all obstacles within 200 feet on either side of the flight path, by 50 feet vertically;

c) after passing the aerodrome boundary, can clear all obstacles within 300 feet on either side of the intended flight path, by 50 feet vertically.

Even when taking off from hard-surface runways of low-altitude, first-class airfields and with the ground air temperature at standard, these requirements limit the DC-3's maximum permissible take-off weight to about 23,600 lbs. and the payload, accordingly, to 3,400 lbs. for a range of 375 miles. *Under these circumstances the DC-3 would be very uneconomical...*

But it is here that our Californian primadonna reveals anew her vitality. She has no intention whatever of leaving the stage! Helping to prolong her success she has in Donald W. Douglas a diligent impresario, and willing partners in aero-engine manufacturers Curtiss-Wright (with the new "Cyclone") and United Aircraft (with the improved Pratt & Whitney "Twin Wasp" and Hamilton Standard propellers); and even Britain has now sent a couple of Galahads to the rescue : Armstrong Siddeley Motors and Rolls-Royce, manufacturers of the "Mamba" and "Dart" propeller-turbines, respectively.

Two solutions, offering a way out of the new take-off safety difficulties, are now being proposed in order to help the DC-3 meet contemporary standards : Douglas's own project for a "Super DC-3" and the more recent suggestions by British engine firms to equip it with turboprops.

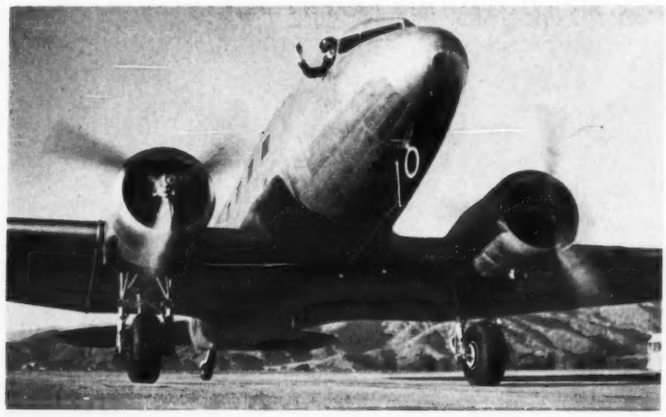
Whereas the Super DC-3 would to all intents and purposes be a new aircraft, with more powerful engines, higher speed, greater passenger capacity, retaining only the wing centre section, fuselage centre portion and main landing gear of its predecessor, the suggested turboprop-powered version would involve no essential modification of the original DC-3 airframe. The Super DC-3 would meet ICAO's Transport Category A standards with a take-off weight of 31,000 lbs.; 26,700 lbs. is the figure stated for the turbine version.

Examination of the design features and performance data reveals a considerable difference between the Super DC-3 and its progenitor. Newly designed outer wing panels have somewhat reduced the size of the wing; it has more sweepback and aerodynamic twist. The tail surfaces, on the other hand, have been enlarged in order to assure minimum control speeds and adequate stability in conformance with newest standards. The main landing gear is now enclosed by doors when retracted, and the tail-wheel has been made partially retractable. The cabin can be made to seat 30 to 37 passengers. Because of the longer engine nacelles the propellers' planes of rotation are further forward, necessitating that the fuselage nose be lengthened accordingly.

There are three alternative power plant installations : Wright 1820-C9HE "Cyclones," Pratt & Whitney R-200-D5 or D7 "Twin Wasps." The first type of engine yields 1,475 h.p. for take-off and 1,275 h.p. rated power; the "Twin Wasp" 1,450 h.p. take-off and 1,200 h.p. rated power. Both engine types are to drive Hamilton Standard "Hydromatic" three-blade propellers of 11 ft. 6 in. diameter. Automatic feathering assures that, in the case of an engine's failing at the take-off, maintenance of the design climbing performance is not dependent merely on whether the pilot can manipulate his cockpit levers with sufficient rapidity.

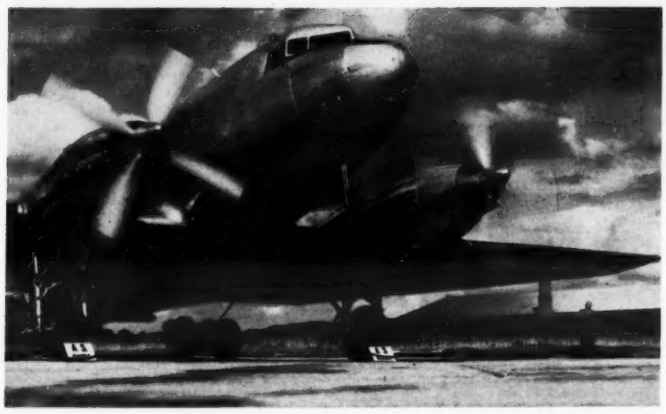
Innumerable details of equipment and interior arrangement have been modified to conform to modern standards. For example, the cabin door has an integral loading step and hand rails, a feature already adapted privately by Southwest Airways to their DC-3s, which has shown its utility in eliminating the need for loading ramps and the ground crews to handle them. Whilst the old DC-3 has two cargo holds, a difficultly-accessible one in front and one at the rear, the Super has simply a large rear cargo compartment at only forty inches from the floor, easily accessible through large doors. Moreover, it is possible to arrange for passengers to handle their own luggage when boarding and leaving the aircraft, thereby saving valuable time.

1935 : The DC-3's engine cowlings, landing gear design and radio aids (short-wave antenna and D/F loop) were considered very advanced.



1946 : A 24-passenger "Dakota" converted for Air France leaves—equipped with additional ferry tanks—a Glendale airfield in California, bound for Paris. Latest radio aids, automatic radio compass (beneath fuselage), instrument landing and marker receiving equipment make for extra safe flying.

1949 : Improved aerodynamics and 23 per cent. more take-off power characterize the Super DC-3. Proven radio aids of the post-war "Dakota" have been retained.



1949 : The airline grandmother tries a less expensive treatment of face-lifting : a DC-3 experimentally fitted with Armstrong Siddeley "Mamba" propeller-turbines.

Hydraulic and electrical systems, air-conditioning and cabin-heating (with additional ground blower), fire-warning and extinguishing equipment have all been improved, though the anti-icing systems, consisting of a rubber shoe type for the wing and tail surfaces, alcohol for the carburettors and propellers, and hot air for the windshield, have been retained. The windshield has been reinforced to withstand the impact of a 4-lb. bird at 248 m.p.h. without penetration. Finally, the entire wing structure has been reinforced so that—in accordance with the greater engine power—the highest permissible level flight speed in gusty air may be raised from 210 to 254 m.p.h. (referred to ground air density) and the other operating speeds improved accordingly.

Two prototype Supers have been built so far, one powered by "Cyclones" and the other by "Twin Wasps." The first one—"Cyclone" powered—made its initial flight last June and, at this writing, is on a publicity flight through the U.S.A. and Canada. Super DC-3 production is slated to begin next May, at the Douglas plant in Santa Monica and eventually by Canadian Car Co. in Montreal. Meanwhile, customers wishing to have their old DC-3s converted into Supers will have to dig down rather deep into their pockets—hard currency division. According to the last reports, conversion into Supers will cost more than the original factory-new DC-3s : 200,000 to 250,000 U.S. dollars. In return, the Super DC-3 offers the possibility of substantially reduced direct operating costs, even down to those figures reached only by fully-loaded 40-passenger airliners.

Whereas the projected conversion of DC-3s into Super DC-3s originates from Douglas Aircraft Co. themselves and represents a considered offer to the airline companies, the replacement of the old piston engines by new turboprops is merely a suggestion. It is true that Armstrong Siddeley have already equipped a "Dakota" with two "Mamba" turbines, and flown it; and it has been stated unofficially that similar experiments are being conducted with Rolls-Royce "Dart" turboprops. But neither of these two engine firms would undertake the quantity conversion of DC-3s into turboprop airliners, and so far no aircraft firm has announced its readiness to do so. Nevertheless, Armstrong Siddeley have released some data on the "Mamba-Dakota" which give a rough idea of the prospects offered by such a conversion.

The costs of this rejuvenation treatment have intentionally been kept as low as possible. The basic idea is, solely by adapting turboprops in place of reciprocating engines, to improve the take-off

Aircraft type		DC-3		Super DC-3		Mamba DC-3	
Engine		Pratt & Whitney R-1830-92 (S1C3G)		Wright R-1820-C9HE		Armstrong Siddeley Mamba	
Propeller		Hamilton Standard Hydromatic		Hamilton Standard Hydromatic		De Havilland Hydromatic	
Span		95'		90'		95'	
Length		64' 5 ½"		67' 8 ½"		64' 5 ½"	
Wing Area		987 sq. ft.		969 sq. ft.		987 sq. ft.	
T. O. power		2×1,200 h.p.		2×1,475 h.p.		2×1,475 h.p.[1]	
Rated power		2×1,050 h.p.		2×1,275 h.p.		2×1,300 h.p.[2]	
Type of transport		Passenger	Cargo	Passenger	Cargo	Passenger	Cargo
Crew		3	2	3	2	3	2
Seats		21+	—	31+[3]	—	21+	—
Tare weight	lbs.	17,100	16,510	19,515	18,125	c.16,100	c.15,500
Oil, residual fuel, aux. equipt.	lbs.	620	260	900	(735)[4]	(620)	(260)
Crew & luggage	lbs.	550	390	550	(390)	(550)	(390)
Fuel incl. reserve[5]	lbs.	1,930	....	2,365	....	(4,050)	(4,050)
Payload, present regulations	lbs.	5,000	7,540	—	—	—	7,800
T. O. weight, present regulations	lbs.	25,200	26,900	—	—	—	28,000
Payload, ICAO Cat. A.	lbs.	3,400	4,240	7,670	9,200	(5,380)	6,500
T. O. weight, ICAO Cat. A.	lbs	23,600[6]	23,600[6]	31,000	31,100	26,700[6]	26,700[6]
T. O. wing loading (Cat. A.)	lb./sq. ft.	24.0	24.0	32.0	32.0	27.1	27.1
One-eng. T.O. power loading (Cat. A)	lb/h.p.	19.7	19.7	21.0	21.0	18.1	18.1
Rated power loading (Cat. A)	lb/h.p.	11.2	11.2	12.1	12.1	10.3	10.3
Max. speed	m.p.h.	234	234	269	269	230	230
on rated power at altitude	ft.	8,000	8,000	5,900	5,900	10,000	10,000
Cruising speed	m.p.h.	191	188	226	226	165-230	165-230
at 10,000 ft. on cruise power		60%	60%	60%	60%	opt.-max	opt.-max
Service ceiling	ft.	25,000	23,000	22,100	22,100	...	....
Rate of climb, sea level	ft./min.	1,230	1,100	1,300	1,300	....	....
Max. range with 800 U.S. Galls. fuel, not consuming usual reserve	miles	1,620	(1,620)	(1,600)	(1,600)	650	650
with payload	lbs.	2,075	4,630	....	....	(5,380)	6,500
at cruising speed	m.p.h.	176[7]	176[7]	....	....	165	165
All perf. data for gross weight	lbs.	25,200	26,900	31,000	31,000	28,000	28,000

OBSERVATIONS :

[1] Equivalent power from 1,320 s.h.p. plus 405 lbs. static thrust.

[2] Equivalent power from 1,150 s.h.p. plus 225 lbs. thrust at 200 m.p.h.

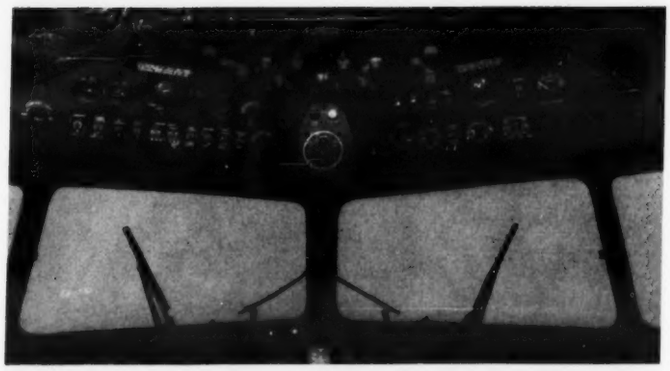
[3] Weights for 31-seat version; 30- and 37-seat arrangements are also offered.

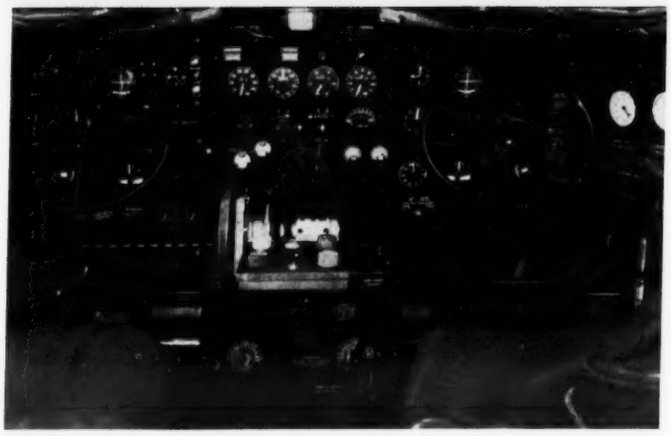
[4] Calculated from 19,250 lbs. operating weight empty.

[5] Fuel supply and reserve apply to 375-mile (DC-3 and "Mamba" DC-3) and 440-mile (Super DC-3) routes plus 200-mile deviation (both in still air) and 45 minutes' stacking. The payload indicated for the DC-3 is limited by the available seats and cargo volume, which explains why the fuel supply allows for a greater range.

[6] Given by Armstrong Siddeley.

[7] At 50% METO, *i.e.*, 525 h.p. per engine.





View of the Super DC-3's cockpit.

performance to such an extent that the DC-3 can meet ICAO's Transport Category A requirements and still remain economical. Thus, the essential change involves replacement of the engines, nevertheless accompanied by modified instrumentation, exhaust system and auxiliaries.

At 15,000 r.p.m. the Armstrong Siddeley "Mamba" at sea level delivers 1,320 s.h.p. for take-off plus 405 lbs. residual thrust—thus about the same total thrust power as a 1,475-h.p. piston engine with controllable-pitch propeller. The maximum continuous power (at 14,500 r.p.m.) is strictly dependent on the flying speed and altitude. At 200 m.p.h., for example, including the exhaust thrust, it amounts to 1,300 h.p. at sea level and 830 h.p. at 15,000 feet. Propulsion is provided by de Havilland four-blade propellers.

A stairway built into the entrance door saves valuable time at airports. Another convenient feature of the Super DC-3 is the easy accessibility to the spacious cargo compartments.

The rear end of the Super DC-3's cabin, showing the quarters of the air hostess and the cabin door with integral step.

Apart from their higher take-off power yield, the "Mambas" have the further advantage that together they weigh about 1,000 lbs. less than the piston engines and therefore allow for a correspondingly higher payload—at least, up to a range of 350 miles. Over greater distances, the turbines' higher fuel consumption begins to offset the gain in weight. However, Armstrong Siddeley are confident that the next year or two will see an appreciable reduction of the "Mamba's" present specific consumption of 0.735 lbs./e.s.h.p. hr. As is usually the case for gas turbines, the mileage consumption (in miles per gallon) varies enormously with the cruising speed, so that the latter—without involving any substantial range penalties—can be stepped up to the strength-dictated maximum level flight speed (about 200 m.p.h. at sea level and 230 m.p.h. at 10,000 feet). The volume of the fuel tanks (804 U.S. Galls. in the C-47 and converted DC-3) limits the maximum range (taking into account the usual reserve for 200 miles deviation and 45 minutes' stacking), to about 650 miles at 10,000 feet. Under these circumstances the passenger version can still carry—abiding by ICAO's take-off regulations, *i. e.*, at 26,700 lbs.—a payload of some 4,100 lbs and the cargo aircraft (which has a lower tare weight) about 5,200 lbs.

Although installed with their longitudinal axes in the same position as the piston engines, the "Mambas" are located further forward for C. G. reasons and the propellers' planes of rotation—in the experimental version—are opposite the pilot's position, which is contrary to ICAO regulations. Future conversions—perhaps by lengthening the fuselage nose—will avoid this flaw. The exhaust system passes over the wing, bifurcates to avoid the undercarriage operating jack, and terminates at about the same spot as the rear end of the original nacelle. The original four pilot's controls (two throttles and two propeller-pitch control levers) are replaced by only two levers, as each "Mamba" requires only a single control lever. Engine instruments comprise tachometers (for 15,000 r.p.m.) and indicators for exhaust temperature, combustion pressure, and main-bearing temperature. An accessories box to each engine contains a 3-Kw generator, a vacuum pump and a hydraulic pump; starting is accomplished electrically. The "Mamba" now boasts a total of more than 8,000 development running hours and has been certificated for both civil and military operation. One engine has successfully completed a 500-hour endurance trial, with only fifteen man-hours of maintenance throughout the test.

The "Mamba-Dakota" made its first flight at the end of last August; since then, several extensive tests have been conducted with it, which have served to furnish more exact performance data (see table) and to show the advantage of turboprops with respect to less vibration and noise. Because the conversion may be carried out with simple means and — apart from the acquisition of the turbines—relatively cheaply, and since amortized DC-3s or C-47s are possessed by nearly all the airline companies, the latter are now faced with the tempting possibility of cheaply gathering operational experience with gas turbines. And as airliners powered by gas turbines of one kind or another may be on the market in a few years, this experience could prove valuable.

Both the Super DC-3 and the "Mamba" DC-3 probably have advantages and disadvantages. Their joint advantage, however, is that they keep a proven, trusted airliner on the wing, call for little if any new training of air and ground crews, and enable old stocks of spares to be used to a large extent. The take-off performance has been improved in both types to conform to ICAO requirements, but the more robust Super DC-3 must necessarily possess a considerably higher block speed, whilst that of the "Mamba-Dakota" is limited by the safety regulations.

It is possible that this rejuvenation treatment may appeal to smaller and consequently poorer airline companies, for in this way they can keep their various "grandmothers" still flying. But those airline operators who can afford to disregard stop-gaps and aim toward increased comfort and performance, are less likely to fall for the idea. Perhaps they will figure that the treatment is all the same not too cheap and the result is still a "grandmother," even though a rejuvenated one. And then they may take the pitiless decision to buy modern, pressurized aircraft.

Rejuvenating the DC-3, therefore, is more a financial problem than anything else—a problem which each operator must solve according to his means.

ILS-2 at European Airports

The International Civil Aviation Organization's recommendation that the U.S. Instrument Landing System should be installed at all intercontinental airports, is being taken more and more seriously. Ten European airports—in France, Norway, Sweden, Portugal, Holland, Ireland and Switzerland — are now being fitted out with ILS-2, the latest version of ILS, capable of meeting all of ICAO's requirements. The first of these went into operation last September at Zurich's new Kloten Airport. Moreover, during the years immediately following the war, several other European airports were equipped with SCS-51, the Signal Corps System developed during the war for the U.S. and Allied governments, which, known commercially as ILS, served as pattern for the since perfected system described here. The two systems operate on exactly the same principles; only the details of their equipment differ. Almost all modern commercial transport aircraft are equipped to receive landing intelligence from ILS-2 or SCS-51 systems. (Older types of airliners can still land from data supplied by SBA-Lorenz or other radio aid systems.)

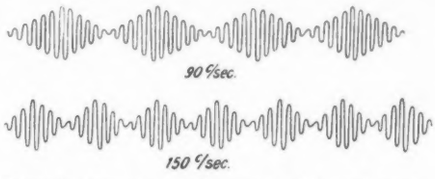
Today's Instrument Landing System is considerably more accurate than any of its predecessors, and consequently enables landings to be made under less stringent minimum conditions of ceiling and horizontal visibility. It gives continued indication of the incoming aircraft's position laterally with respect to the extended centre-line of the runway and also of its altitude relative to a predetermined fixed descent path, thereby enabling the pilot to approach, with great precision, the point-of-contact on the runway.

The first prototype system, developed by Federal Telephone and Radio Corporation (an associate company of International Telephone and Telegraph Corp.), was installed and tried out for the first time in 1939 at Indianapolis. During the war numerous portable SCS-51 installations were made at U.S. and Allied air bases, Federal having been commissioned to design and manufacture some 500 such systems. Some of these were purchased after the war for installation, as non-mobile systems, at various civil airports. Additionally, Federal designed remote monitoring and control units for a civil version of SCS-51, putting it into production in 1946 as the FTR-51. And now, after various perfections—notably in the antenna arrangements and the introduction of a telephony channel—the system has received the final designation ILS-2.

Radio signal patterns form two guiding paths

It is familiar knowledge that in ILS radio signal patterns are so radiated as to form two intersecting surfaces which guide the pilot along the desired approach line to the runway. One of these is perpendicular to the runway and aligned with its centre-line; it finds its origin in a Localizer transmitter. The other is an oblique path, in the nature of the surface of a cone standing on its apex, and originates from a Glide Path transmitter, erected to one side of the point-of-contact. The aircraft's correct approach line is defined by the intersection of these two paths. Deviations from the line thus defined are indicated by corresponding deflections of the needles on a cross-pointer instrument in the cockpit.

Each path is a zone of equal field strength of two different types of radio signal. The latter are emitted on exactly the same carrier frequency — and therefore have the same wavelength, in the metre and decimetre wavebands—but their amplitudes are modulated according to two patterns (left and right—up and down) with 90 and



Signals from the localizer and glide path transmitters are modulated with 90 and 150 cycles; wavelength and peak amplitude remain the same.

150 cycles per second. One therefore refers to them as modulated continuous waves (MCW), in this case with 90 and 150 cycle modulation.

For reliable and accurate results it is imperative that the amplitudes of the two MCW signals should not alter their ratio along the path; thus that there be no course shifting due to aging or failure of the transmitter tubes or components. For this reason *mechanical* modulation has been adopted. Briefly, the mechanical modulator consists of an electric motor turning at 1,800 r.p.m., on whose shaft are mounted a pair of rotary capacity switches, one having three blades (3 x 30 = 90 c/s) and the other five blades (5 x 30 = 150 c/s), enabling 90 and 150 c/s modulation to be impressed simultaneously on to the two signals.

Outside the paths of equal field strength —thus the localizer and glide path—the amplitude of the two signals differ in magnitude. This difference causes the above-mentioned cross-pointer indicator to function. Signals from the ground transmitters are picked up by the aircraft's dipole antennae and special receivers, and separated therein by selective filter circuits; the resultant voltages are then rectified and fed to a centre-zero d.c. meter. In this way no deflection occurs when the aircraft is on course—on the equi-signal line where equal voltages prevail; but there are deflections in the directions of the 90 and 150 c/s zones—indicating to the pilot that he is flying above or below the glide path, to the right or left of the localizer : pointer deflections to the left tell the pilot to "fly left," deflections upward tell him to "fly up," etc.

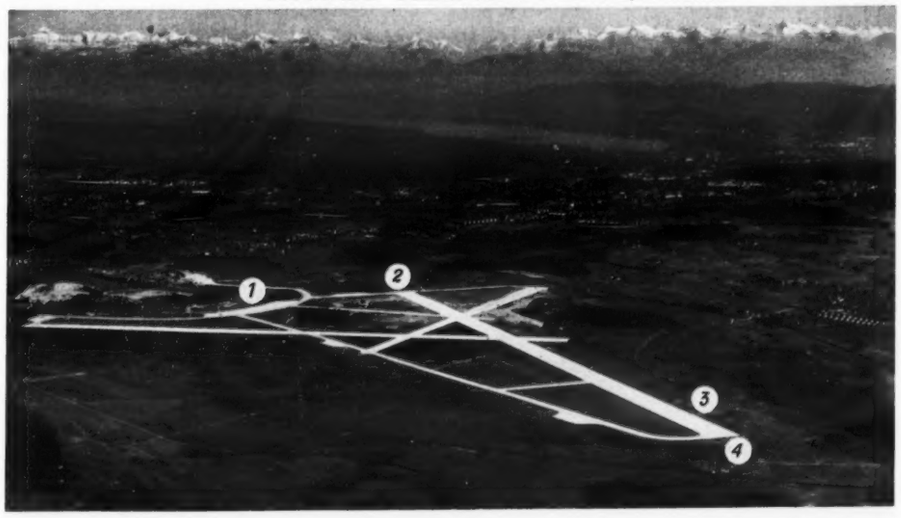
Ground installations

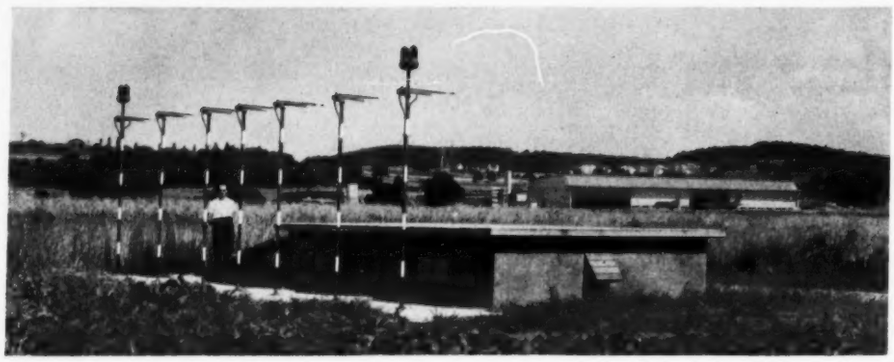
The ILS-2 ground installations comprise five fixed-position transmitters with special antennae, and a monitor and control system :

1) localizer transmitter and antenna,
2) glide path transmitter and antenna,
3) outer marker beacon,
4) middle marker beacon,
5) boundary marker beacon,
6) monitoring and control equipment.

The localizer transmitter together with its antenna array is situated on the extension of the runway centre-line, about 1,000 feet beyond the upwind end of the runway foreseen for instrument landings. Usually the transmission hut is partially sunk into the ground (as at Zurich-Kloten Airport)

Zurich's Kloten Airport seen from the air. The various ground components of the airport's ILS-2 system are indicated. 1 Control tower 2 Localizer transmitter 3 Glide path transmitter 4 Boundary marker





Showing the partially submerged localizer transmission hut and antenna array at Kloten. Red warning lights are mounted on top of the outer dipoles.

Kloten's glide path transmission equipment (top to bottom): obstacle warning lights, upper antenna system (two dipole antennae and reflectors), hut housing transmitter, lower antenna and reflector (under a plastic cover for protection against snow).

in order not to act as an obstacle in the path of aircraft eventually having to go round again after an abortive approach; the antenna masts stand only ten feet in height.

The glide path transmitting equipment is positioned about 700 feet from the downwind end of the runway, and 400 feet to the side.

The three marker beacons, radiating their beams vertically, are installed along the extended runway centre-line at 4½ miles, 3,500 feet and 250 feet from the runway threshold. They serve as landmarks which advise the pilot, optically (by lighting up different coloured lamps on the instrument panel) and aurally (different cycle tones, dots and dashes), of his proximity to the point of touchdown when approaching on the localizer.

Localizer equipment

The high-frequency part of the transmitter operates on one of the six international localizer frequencies between 108 and 102 megacycles—thus in the VHF band. It contains an exciter unit and two separate output channels. One of the latter, the main channel, delivers 300 watts peak RF power to the mechanical modulator unit for the 90 and 150 c/s signals forming the localizer field pattern. The other one, known as the auxiliary channel, supplies 100 watts of RF power to be used interchangeably for simultaneous voice or keyed identification transmission. For this, the same carrier wave is modulated by a 1,020 c/s tone, automatically keyed, transmitting the airport's identification letters (*e.g.*, Z-Z-Z-Z for Zurich-Kloten) every six seconds. When voice transmission is required, these identification signals are interrupted for as long as the carrier wave is modulated with voice frequency.

The antenna array consists of seven folded, current-fed dipoles arranged in a row, emitting horizontally polarized beams. Thanks to this disposition, and corresponding distribution of the energy radiated, a strong concentration of the two 90 and 150 c/s signals parallel to the runway is achieved. Besides this, the centre antenna additionally radiates the voice and identification signals. A course monitor is located 150 to 200 feet in front of this antenna array, checks the accuracy of the transmissions, and causes an alarm to be given in the control tower should the direction of the localizer path change by more than a ¼-degree, the modulation frequency cease, or the field strength drop to below half its normal value. At altitudes of more than 2,000 feet the localizer transmissions can be picked up over a range of at least 20 miles.

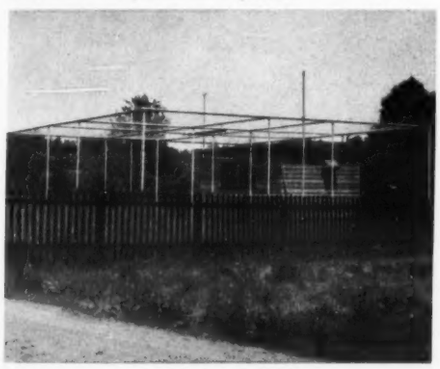
Glide path equipment

The glide path transmitter differs from the localizer in that it operates in the UHF band, with carrier frequencies which can be fixed arbitrarily between 329 and 335 megacycles. But the modulation frequencies are the same. The RF section delivers 50 watts peak power to the mechanical modulator. At about six miles in front of the runway, incoming aircraft enter the effective zone of the glide path transmitter and are then guided at a given angle, mostly 2½ degrees, to the point of touchdown. This angle can be set at will between two and four degrees in steps of a ¼-degree.

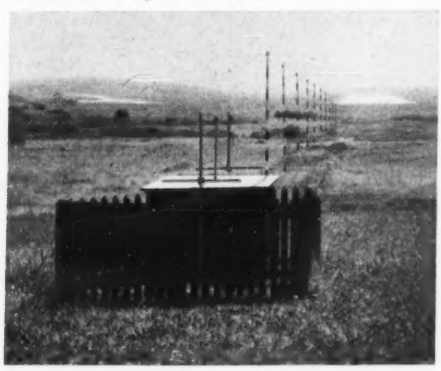
The antenna system differs radically from that of the localizer. Its equi-signal pattern is not a plane but the surface of a large-aperture cone. This is because the 150 cycle modulated signals are radiated, in the form of thin beam arrays of conical shape, from *two* dipoles (with reflectors) mounted at the top of an antenna mast, whilst a single dipole at the lower end of the same mast sends out a thicker conical array of 90 cycle modulated waves. Intersection of the radiation patterns from the upper and lower antennae results in not one but two conical surfaces the upper one of which, however, ascends so sharply that it cannot be followed by an aircraft and no confusion is possible. The lower surface is the glide path.

The fact that the glide path antennae are located to the side of the runway centre-line incurs a difficulty. The line of intersection of glide path and localizer, defining the aircraft's approach line, is a hyperbola which, if the axis of the cone were vertical, would not touch the runway. Thanks to a slight rotation of the upper antenna, however, the surface lines of the glide path cone are tilting differently and the hyperbola so deformed that it almost touches the

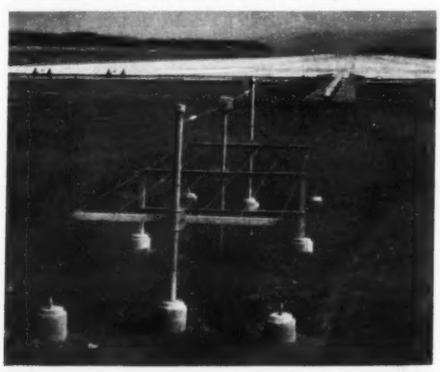
The outer marker beacon is at Hochfelden, a village about four miles from Zurich's big airport, and on the extension of the runway centre-line. The wire net forms the reflector.



The middle marker is installed at Oberglatt. Behind it can be seen the row of lights for indicating the direction of Kloten's instrument runway in bad visibility conditions.



The antenna of Kloten's boundary marker is located only 250 feet from the runway threshold. Consequently, it is very low above the ground and the transmission hut is below the surface.



runway. In this way a glide slope is obtained which is exactly adjusted to the ideal approach path.

A monitor unit located in front of the glide path transmitter constantly checks its position, giving alarm indication in the control tower if the glide path shifts by more than a ½-degree, if the modulation ceases or the field strength drops to below half its normal value.

Marker beacon equipment

Each marker beacon is a crystal-controlled transmitter operating on 75 Mc/s (of 2 watts power) having a horizontal, straight dipole array with horizontal reflectors. Their vertically-radiated, conical signal patterns are each identified by a characteristic modulation frequency and keying rate. The outer marker, modulated with 400 cycles, emits continuous dashes; the middle marker, with 1,300 cycles, alternate dots and dashes; and the boundary marker, having 3,000 cycle modulation, is identified by continuous dashes.

The outer and middle markers have their dipoles and reflectors on the roof of the huts housing the transmitters. In the case of the boundary marker the antenna, for safety reasons, is located very low above the ground and the actual transmitter is positioned to one side of the approach line.

ILS-2 monitor and control equipment in the temporary control tower at Kloten. On the left may be seen the servicing equipment for the old SBA-Lorenz system. The traffic controller's communications with incoming aircraft are made via the localizer transmitter and may be recorded on Dictaphone belts.

Remote control and monitor equipment

The entire instrument landing system can be switched on, controlled, and switched off from the airport control tower, where there is also the microphone installation enabling the traffic controller to give aural instructions to incoming aircraft. Any shortcomings of the system are immediately warned of in the control tower and may be reported to aircraft without loss of time. To facilitate maintenance and adjustment work, all five outlying installations are connected by telephone with the control tower.

In order to provide maximum reliability of operation it is foreseen that all components apt to fail—because of tube deterioration, etc.—should be duplicated. In the case of a breakdown in such a dual installation, the spare component begins to operate automatically, thereby enabling the entire system to keep in constant operation. The majority of ILS-2 systems now being erected have dual installations, and this safety feature is planned as a later supplement for existing systems.

Turbojet Intake Configurations

By A. W. Quick *

Turbojet engines, which are at present entering the field of aircraft propulsion in increasing numbers, differ considerably from reciprocating engines notably as regards the amount of air they inhale : turbojets require ten to twenty times as much air as piston engines do. Consequently, an important part of the jet aircraft constructor's job is to design a system of air intake incurring the smallest possible losses. The air intake must satisfy three requirements :—

1. The flow of air passing through the intake channel to the engine must suffer the smallest possible losses. Thus, the "internal" losses must be slight.
2. The intake channel must fit in well with the general configuration of the aircraft and produce the smallest possible "external" losses.
3. The intake channel's opening must be positioned in such a way as to prevent the entry of grit during take-offs and landings.

1. *The "internal" losses of a normal intake*

We shall define as an "internal" loss one in flow energy which occurs in the intake channel on the way from the intake opening's flow stagnation point to the engine's inlet, *e. g.*, the compressor inlet. It can be expressed as follows :

$$\zeta = \frac{\Delta P}{q_1} \qquad (1)$$

in which :

- ζ = loss coefficient of intake flow,
- ΔP = total pressure loss between intake opening and entry to engine,
- q_1 = dynamic pressure at entry to engine.

If the total pressure loss ΔP is to be ascertained experimentally, it can be defined in approximation as a mean value :

$$P = \frac{1}{m} \int_{r_i}^{r_e} [P_0 - P_1]\, dm \qquad (2)$$

in which :

- m = total mass of air utilized by engine,
- P_0 = total pressure of external flow,
- P_1 = local total pressure at entry to engine,
- dm = air mass flowing through annular cross-section,
- r_i = internal radius of entry cross-section to engine,
- r_e = external radius of entry cross-section to engine.

The reference pressure q_1 may be selected arbitrarily. But in order to obtain the smallest possible fluctuation of ζ in a given intake channel for the various flight configurations, it will be profitable to select a value prevailing in the engine channel, *e. g.*, the dynamic pressure at the entry to the engine. Though this is variable, depending on the flight configuration and the magnitude of the losses in the air intake channel, there is nevertheless only a slight variation from the value :

$$q_1 = \frac{\rho_1}{2} \cdot v_1^2 \qquad (3)$$

in which :

- v_1 = mean speed at entry to engine. (Engine manufacturers give this as mean value for different flying speeds, altitudes and intake losses. For the ATAR 101B turbojet [1] this value, *e. g.* for full load, amounts to 154 m/sec. Assuming the usual losses it does not vary by more than ± 3 percent.)
- ρ_1 = air density at entry to engine; when losses occur, this amounts to :

in which :

$$\rho_1 = \rho_{1i} \cdot \left(1 - \frac{\Delta P}{P_0}\right)$$

* Aéroplanes Voisin, Groupe Technique. Decize/Nièvre, France.

[1] INTERAVIA, Review of World Aviation, Vol. IV, No. 6, pp. 345-349.

ρ_{1i} = air density during isentropic change of the air from external condition to condition v_1

P_0 = total pressure of flow without loss

If ζ is to be ascertained experimentally it naturally will be profitable to define q_1 as a mean value, like ΔP in equation (1).

Decreases in engine output can now be indicated in function of this loss coefficient ζ. Using the ATAR 101B turbojet as example, Fig. 1 presents the percentage change in thrust $F/F_{(\zeta = 0)}$ and specific fuel consumption $c/c_{(\zeta = 0)}$ for static operation and high-speed flight at altitude. Curves pertaining to the intermediate values of altitude and speed run between the two curves in the shaded area, so that the thrust decrease and consumption increase, in view of the almost linear variation, can be given as :

$$F/F_{(\zeta = 0)} = 1 - a \cdot \zeta \qquad (4)$$

in which $0.24 < a < 0.28$

$$c/c_{(\zeta = 0)} = 1 + b \cdot \zeta \qquad (5)$$

in which $0.12 < b < 0.15$

Nevertheless, in the case of very irregular distribution of speed there arise further losses due to drops in compressor efficiency. These can be ascertained experimentally at the engine for each case under consideration.

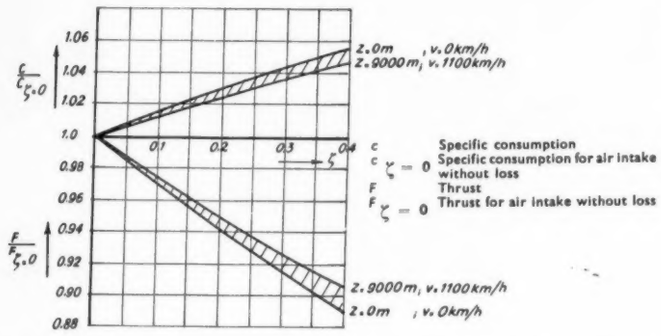


Fig. 1 : Thrust and fuel consumption variation versus intake loss coefficient at different flying speeds v *and altitudes* z.

The values given above are naturally dependent upon the layout of the engine and are therefore valid only for engines working with pressures and temperatures of the same order. Furthermore, they are influenced by the magnitude of the losses in the exhaust outlet; the repercussions of these losses on the values given in Fig. 1 are all the same slight, so that the two factors can be considered independently without involving much error.

2. *Losses with boundary-layer suction*

In addition to the usual type of air intake consisting of an opening at the forward end of the aircraft, a wide intake can be placed at some distance above the surface of the aircraft, which is used for boundary-layer suction to cut down drag and postpone the compressibility shocks. In this case the intake conditions for the engine are modified considerably, and the drag calculation for the airframe can no longer be effected separately from that of the engine thrust.

It will be remembered that the thrust F of a turbojet is ascertained from the difference between the entry and efflux impulses (occurring far in front of and far behind the aircraft) of the air and fuel mass flowing through the engine :

$$F = (m_A + m_F) \cdot v_5 - m_A \cdot v_0 \qquad (6)$$

in which :

m_A = air mass flowing through engine,
m_F = injected fuel mass,
v_5 = jet velocity behind the aircraft,
v_0 = flying speed.

With a view to calculating the performance of the aircraft, a difference must now be made as to whether the entire thickness of

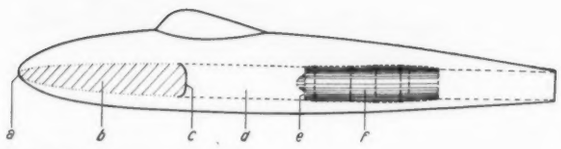


Fig. 2 : Intake in side of fuselage.

a Airflow stagnation point
b Fuselage surface within flow of air entering engine
c Intake opening
d Intake channel
e Entry to engine
f Turbojet engine

Fig. 2a : Vickers Supermarine "Attacker" jet fighter.

the boundary layer is to be sucked off and fed to the engine, or whether only a part of it is involved. In the first case the loss calculation can be carried out as shown in equation (1),*i.e.*, the total pressure loss from the air intake to the engine entry must be ascertained. But it must be considered that the friction drag of all airframe surfaces touched by the air entering the engine has already been accounted for in the reduction of engine thrust and may not appear in the total drag of the airframe. Thus, in the case of suction on the wing, the wing's friction drag from the point of airflow stagnation to the suction slot is accounted for in the reduction of engine thrust and must consequently be disregarded when calculating the drag of the airframe. The same applies for a normal intake at the side of the fuselage, as shown in Fig. 2. Under these circumstances, owing to the air flowing through the engine, the friction drag occasioned by the fuselage is contained in the reduction of total pressure at the entry to the engine. Consequently, the shaded area b of the fuselage is to be disregarded in the airframe drag calculation.

If only a part of the boundary-layer thickness is fed to the engine, it is best to adjust the engine calculation to the conditions prevailing at the suction slot; otherwise the separation of airframe drag and thrust calculation becomes complicated. Fig. 3 shows the example of wing suction where only a part δ_a of the entire boundary-layer thickness δ is fed into the suction channel. The airflow in this channel has already suffered an impulse loss ΔJ before the suction slot, amounting to :

$$\Delta J = m \cdot (v_a - v_m) \qquad (7)$$

in which :

m = mass flowing per second in the suction channel.

$$= \int_0^{\delta_a} \rho \cdot v \cdot dy$$

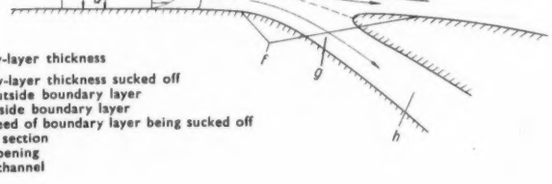
v_a = speed at outer edge of boundary layer

v_m = mean constant speed of air mass m possessing the same impulse loss as the virtual speed distribution imparts to it :

$$v_m = \frac{1}{m} \cdot \int_0^{\delta_a} \rho \cdot v^2 \cdot dy$$

The engine performance date must now be know in dependency of v_m/v_a. In Fig. 4, using the ATAR 101B as example, the change

Fig. 3 : Intake conditions with boundary-layer suction.



δ Boundary-layer thickness
δ_a Boundary-layer thickness sucked off
v_a Speed outside boundary layer
v Speed inside boundary layer
v_m Mean speed of boundary layer being sucked off
f Aerofoil section
g Intake opening
h Suction channel

in thrust and fuel consumption in function of v_m/v_a is plotted for different speeds at 9,000 metres altitude. A very favourable zone, in which a considerable reduction in fuel consumption arises without the thrust changing substantially, occurs at flying speeds v_0 between 400 and 600 kms/hr. At greater flying speeds, however, a sharp drop in thrust due to the increased inlet temperature and the lack of dynamic compression becomes noticeable, which is not compensated by the diminution of the inlet impulse (negative term of equation 6). At lower flying speeds, on the other hand, the diminished inlet impulse does counteract this, and even occasions increased thrust and reduced fuel consumption.

The values given in Fig. 4 will of course continue to be influenced by losses in the air channel between the suction slot and the engine, so that corrections must be made which will give results similar in value to those indicated by equation (1) and Fig. 1.

Taking the drag of the entire aircraft into consideration, attention must now be paid to the fact that the friction drag arising outside the suction slot must naturally be accounted for when calculating the airframe drag. Since the purpose of boundary-layer suction is to reduce this drag, it follows that the gain will be greater for a lower flying speed. At high speeds the sharp drop in engine thrust will offset the greater part of the saving in drag; space requirements and weight of the suction installation are further disadvantages of this arrangement. On the other hand, it could be advantageous, precisely at high speeds, to suck off the boundary layer from particularly exposed zones with a view to alleviating the undesirable effects of compressibility shocks and improving the flying qualities.

3. *The "external" losses of the engine installation*

Compared to reciprocating engines, turbojets offer very many different possibilities as regards installation in the airframe. Though the organic dovetailing of engine and airframe is facilitated in the design of the latter, the final design of the air channel and the positioning of the air intake opening nevertheless present numerous difficulties. The designer will invariably aim at keeping the "external" losses as small as possible—*i. e.*, the various types of drag arising at the outer cowling of the engine.

In order to ascertain this drag we must first know exactly of what components it is made up. By applying the laws of impulse and energy as well as the principle of continuity for inner and outer flow, the thrust given in equation (6) may be defined as follows :

$$F = (m_A + m_F) \cdot v_5 - m_A \cdot v_0 = F_1 + \int_A^{BCDEA} p_x \, dF + \int_A^{BCD} \tau_x \, dF \qquad (8)$$

in which :

F_1 = summation of all forces in x-direction (= flight direction) which, in the form of pressure and friction forces, affect the parts inside the engine that are completely submerged in the air flow,
p_x = pressure components in x-direction,
τ_x = shear stress components in x-direction.

See Fig. 5 for further annotations.

The pressure integral contains all virtual pressure forces acting at the outer edge of the inner flow, beginning from the flow stagnation streamline *AA'* and extending along *BB'CC'DD'*, as well as the pressure forces of the frictionless and shock-free outer flow along *AA'EE'DD'*. The shear stress integral contains all friction forces acting at the outer edge of the inner flow, along *AA'BB'CC'DD'*.

In other words, there now remains only the effect of friction and eventual compressibility shocks at the outer contour along *AA'EE' DD'* to be accounted for with respect to the total drag of the airframe.

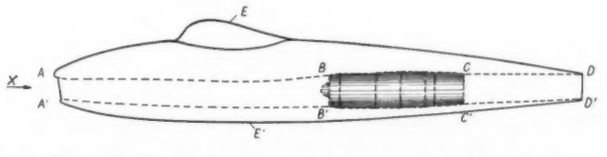


Fig. 5 : Determination of the effects of engine forces on the airframe.

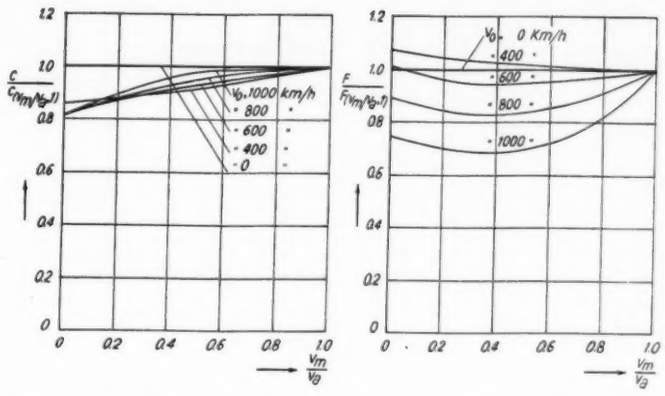


Fig. 4 : Variation of thrust and fuel consumption versus mean suction speed v_m/v_a *for different flying speeds* v_0 *at 9,000 m. altitude.*

The friction produces shear stresses on the walls and also supplementary pressure forces, seeing that the boundary-layer thickness or break-aways modify the pressures of the frictionless flow; these differences have to be brought into the calculation. The losses of the inner flow along *AA'BB'CC'DD'*, however, are, as shown earlier, already accounted for by the decrease in engine thrust.

Because of the proximity to sonic speed, high flying speeds involve a substantial difficulty as regards the flow around the leading edge portion. At high speeds the dynamic pressure is generally considerable in front of the intake, because the velocity of the air entering the engine is well below the flying speed. The result is that excesses of speed occur in the outer part of the inlet's leading edge. In order that these should not locally exceed the speed of sound, the leading edge must feature a certain thickness and contour. As regards intakes consisting of slots or bodies of revolution, these conditions are known for incompressible flow,[2] the minimum thickness of the leading edge being given by the following equation for flow about a body of revolution :

$$\left(\frac{R_a}{R_e}\right)_{min} = \sqrt{1 + \frac{(1 - v_e/v_0)^2}{\left(\frac{v_{max_i}}{v_0}\right)^2 - 1}}$$

in which (see Fig. 6) :

R_a = outer radius of cowling,
R_e = inner radius of cowling at leading edge,
v_e = speed at inlet, referred to πR_e^2,
v_0 = flying speed,
v_{max_i} = max. speed at outer contour for incompressible flow.

Accordingly, for the case of two-dimensional flow along a wall *b* :

$$\left(\frac{R_a}{R_e}\right)_{min} = 1 + \frac{(1 - v_e/v_0)^2}{\left(\frac{v_{max_i}}{v_0}\right)^2 - 1}$$

in which :

R_a = distance from outer profile of leading edge to wall,
R_i = distance from inner profile of leading edge to wall.

In Fig. 6 v_{max_i} is plotted for flow around a body of revolution (ellipsoid) and for two-dimensional flow (ellipse) versus the Mach number; these values denote those local speeds under conditions of incompressible flow that are equal to the local speed of sound under conditions of compressible flow.

Introduction of these values into the two preceding equations yields the minimum cowling thicknesses R_a/R_e plotted in Fig. 7 against the flow v_e/v_0 and the Mach number in flight, M_0.

[2] Ruden, Jahrbuch der deutschen Luftfahrtforschung 1941; Küchemann, Schrift 5004/43 der deutschen Akademie der Luftfahrtforschung.

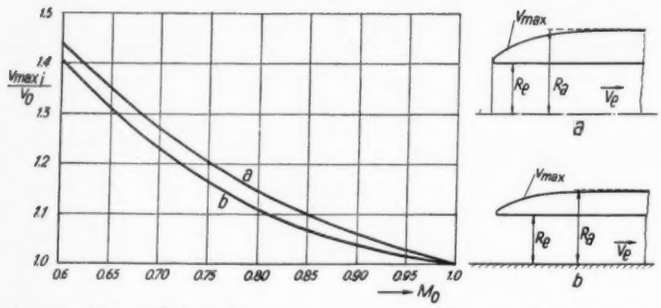


Fig. 6 : Permissible speed excess $v_{max\,j}$ *versus Mach number* M_0 *under conditions of incompressible flow.*

a Flow around a body of revolution (ellipsoid)
b Two-dimensional flow (ellipse, 2nd approximation according to Busemann)
v_0 Relative airspeed

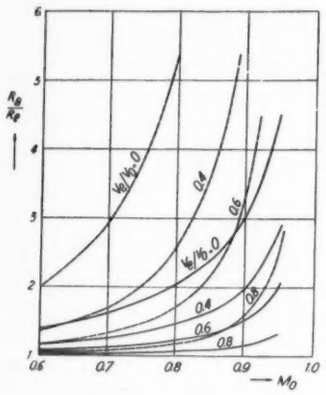


Fig. 7 : Minimum relative thickness R_g/R_e *of intake leading edge versus Mach number* M_0 *and flow quantity* v_e/v_0.

Flow around a body of revolution
Two-dimensional flow

a Optimum contour for high-speed flight
b Contour with enlarged leading-edge radius
ve Speed in air intake channel, referred to R_e

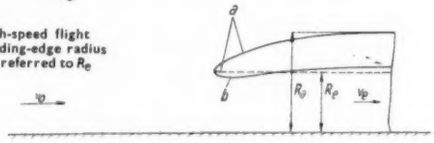


Fig. 8 : Adaptation of leading edge for take-off flight configuration.

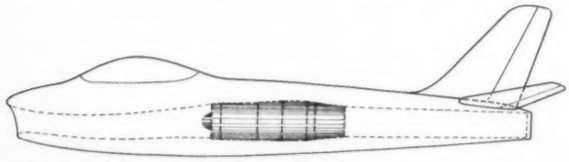


Fig. 9 : Installation in fuselage, intake in nose.

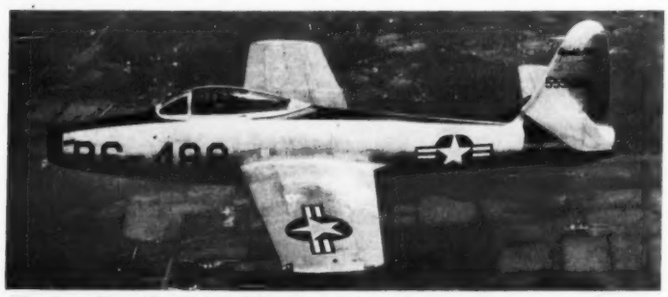


Fig. 9a : Republic F-84 "Thunderjet" jet fighter.

It is evident that, at speeds near to sonic speed, local excesses of sonic speed are almost unavoidable and, therefore, that the occurrence of compressibility shocks at the outer contour of the intake leading edge must be expected. Meanwhile, it has been seen from numerous tests that the resultant drag does not necessarily augment quickly. Its increase will be dependent to a large extent on the position of the shock relative to the airflow stagnation point and on the shock's length measured at 90 deg. to the outer cowling. The nearer the shock to the airflow stagnation point, *i. e.*, the thinner the boundary layer, and the shorter the shock, *i. e.*, the greater the speed gradient perpendicular to the cowling wall, the less danger there exists of the flow's breaking away aft of the shock and of a transition from a straight to an oblique shock. Evidently, therefore, it is advantageous to have the shock occur as near as possible to the intake's leading edge. This was confirmed by measurements made for a lift coefficient of 0.4 to 0.6 on wings having a 12 percent aerofoil thickness and relatively small radii at the leading edge : no increase in the drag coefficient was observed up to M = 0.8, although local excesses of sonic speed occurred already at M = 0.5.

A further difficulty as regards the flow around the leading edge occurs during the take-off, when the danger arises of the flow breaking away from the inner contour. The leading edge of minimum thickness and giving rise to excesses of speed that are constant, designed, according to the above viewpoint, for high-speed flight, features a very small leading-edge radius which has to be enlarged because of the take-off conditions. This is done profitably in the manner shown by Fig. 8. It is to be expected that, with v_e/v_0 remaining constant, no great change will arise in the outer flow during high-speed flight, excepting, of course, in the region adjacent to the leading edge. But according to the opinions elaborated above, a premature excess of sonic speed should incur less disagreeable consequences here than elsewhere.

4. *Possibilities of installing turbojets*

The principal ways in which a turbojet can be installed in a fuselage are shown schematically in Figs. 9 to 17.

The method shown in Fig. 9, used rather frequently, offers undeniable advantages from the engine standpoint, but incurs the disadvantage that the intake and efflux channels require a great amount of space, making it necessary to design a relatively large fuselage.

This disadvantage disappears to a certain extent in the method shown in Fig. 10, but, due to the curved intake channel, problems

Fig. 10 : Installation in fuselage, ventral intake.

Fig. 10a : SO 6020 "Espadon," a heavy jet fighter built by SNCA du Sud-Ouest.

Fig. 11 : Installation in fuselage, lateral intake.

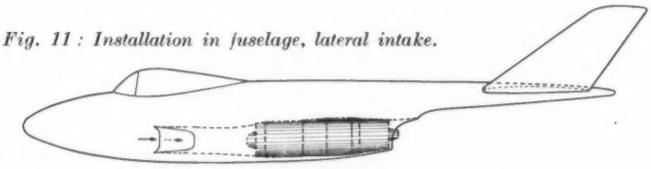


Fig. 11a : Grumman F9F-2 "Panther" naval jet fighter.

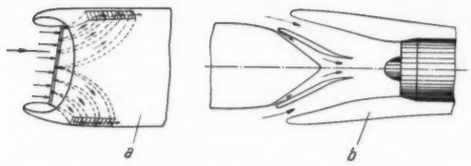


Fig. 12 : Boundary-layer suction at air intake.

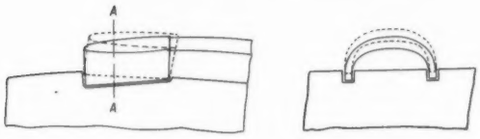


Fig. 13 : Adjustable intake.

arise with regard to the determination of its flow losses, which are further increased by the boundary layer of the fuselage parts located in front. Furthermore, the position of the intake beneath the fuselage makes it necessary to adopt protective measures against grit entering the channel.

Whereas the arrangement shown in Fig. 11 does not feature this disadvantage, reduces the losses due to a long efflux conduit, and does not require an excessive amount of installation volume, it entails—except in the case of tailless aircraft—a number of difficulties as regards the flow around the joint between engine and tail-booms; also, it gives rise to static problems with respect to the slender tail-booms. The intake on the side of the fuselage, with a long boundary layer preceding it, has to be studied very thoroughly in view of the curved intake channels. The boundary layer is not capable of overcoming, in the direction of flow, the high pressure gradients

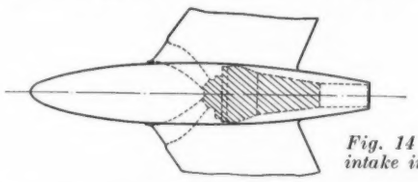


Fig. 14 : Installation in fuselage, intake in wing leading edge.

Fig. 14a : De Havilland D. H. 108 "Swallow" experimental jet aircraft.

produced as a result of the compression of the flow at high-speed flight and the curving of the lines of flow. Boundary-layer suction as portrayed by Fig. 12a has already been employed; suction by means of the engine (fig. 12b) is likewise possible. An adjustable intake, of which the cross-section could be varied according to the flying speed, would be a worth-while improvement—two or three positions, for take-off, cruise and high-speed flight, would perhaps suffice (see Fig. 15).

The concept revealed by Fig. 14 avoids the difficulties of the forward-situated boundary layer and is also advantageous from the standpoint of space requirement. However, a sharply curved intake channel is still necessary. Furthermore, it is evident that the intake has the effect of decreasing the load on the aerofoil, owing to the fact that the thickness of the boundary layer (measured far in front of the wing) diminishes by the same amount the effective aerofoil thickness. Nevertheless, an approximate calculation of the flow with suitably distributed sources and shafts serves to show that this advantage is effective only for the forward part of the aerofoil, whilst at the rear part its action cancels out almost completely owing to the lack of escape flow. All the same, owing to considerable shifting of the airflow stagnation points as the flying speed varies, large excesses of speed and premature excesses of sonic speed occur at the intake's leading edge. But the occurring shock

Fig. 15 : Installation in fuselage, dorsal intake.

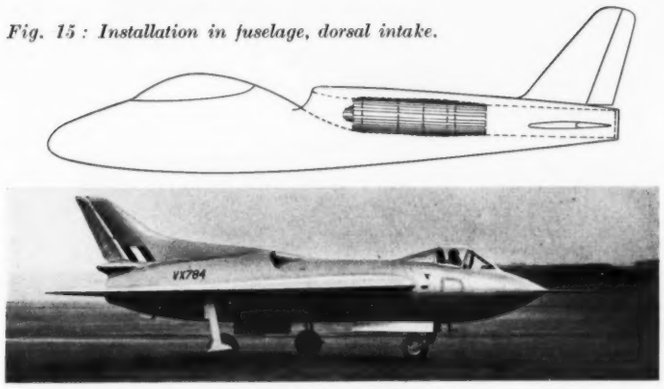


Fig. 15a : Avro 707 high-speed research aircraft.

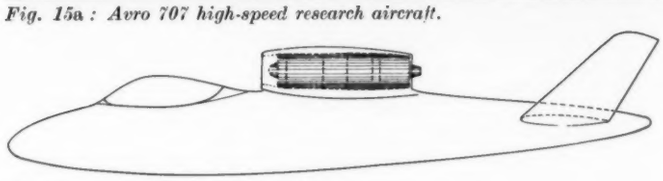


Fig. 16 : Installation above fuselage.

Fig. 16a : Heinkel He 162 "Volksjäger" jet fighter.

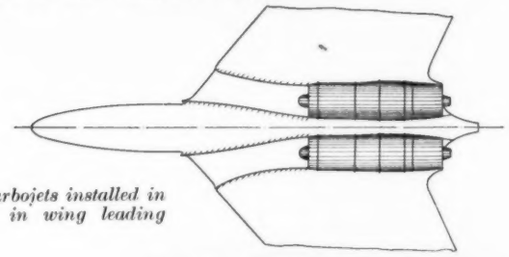


Fig. 17 : Two turbojets installed in fuselage, intake in wing leading edge.

Fig. 17a : Northrop X-4 high-speed research aircraft.

waves need not immediately produce a substantial increase in drag, as the boundary layers are thin and the extension of the shocks perpendicular to the contour remains small. However, these processes are so unfamiliar that reliable numerical indications cannot be given. Here, too, the adjustable intake cross-section would be advantageous.

Fig. 15 shows the possibility of installing a turbojet inside the fuselage with the intake mounted dorsally. Except for the question

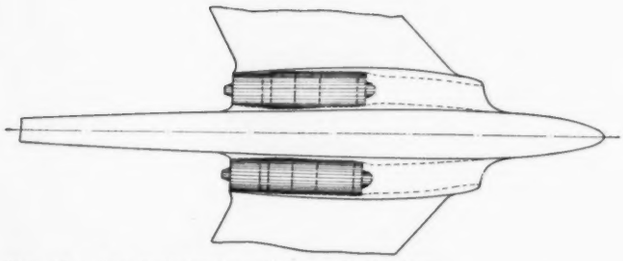


Fig. 18 : Two turbojets installed outside fuselage.

Fig. 18a : McDonnell F2D-1 "Banshee" naval jet fighter.

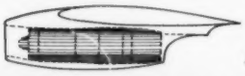


Fig. 19 : Installation beneath wing.

Fig. 19a : Martin XB-48 six-jet bomber.

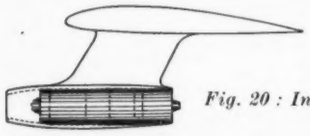


Fig. 20 : Installation beneath swept wing.

Fig. 20a : Boeing B-47 "Stratojet" six-jet bomber (inboard engine pairs).

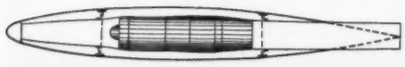


Fig. 21 : Axial-flow turbojet installed in wing.

Fig. 21a : Northrop YB-49 flying-wing bomber, powered by eight axial-flow jets.

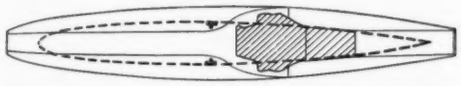


Fig. 22 : Centrifugal-flow turbojet installed in wing.

Fig. 22a : De Havilland D.H. 106 "Comet" airliner, powered by four centrifugal-flow jets.

of grit entering, the same applies here as for the arrangement presented by Fig. 10. It should be added that the cabin roof will give rise to other complications, due to the very pronounced rear boundary layer.

A high positioning of the power plant, as shown in Fig. 16, circumvents the necessity for curved intake channels and also incurs certain advantages as regards aircraft stability. All the same, the pilot's view towards the rear is impaired; the joining of fuselage and engine nacelle increases the frontal area and necessitates careful studies and tests before the critical Mach number for the entire aircraft can be adjusted to a favourable value.

Two possibilities for a twin-jet aircraft are shown in Figs. 17 and 18; the arrangement presented by Fig. 17 offers a thoroughly acceptable solution for both tailless and conventional airframes. The difficulties attributed to the concept of Fig. 14 are nevertheless here, too, though not so pronounced thanks to the slighter curvature in the air intake channels.

Subsequent diagrams show the installation of one or more turbojets outside or inside the wing. The underslung type of mounting, as shown in Fig. 19, is used very frequently for attaching engines, singly or grouped in one nacelle, when the wing is too thin to allow for a buried installation. The arrangement can, however, lead to difficulties if the wing is swept back (to increase the critical Mach number), as the parts of the nacelles situated in front of the wing and in the leading zone of the wing disturb the actual flow of the swept wing and bring the critical Mach number down. Consequently, the arrangement shown in Fig. 20 has been adopted, which partly avoids this disadvantage. The most desirable installation naturally results when the wing chord is large enough to enable the engine to be buried completely, as shown in Fig. 21. In this respect, the turbojet having an axial-flow compressor is, in view of its much smaller frontal area, far superior to the centrifugal-flow type; this is immediately apparent from a comparison of Figs. 21 and 22.

(To be continued)

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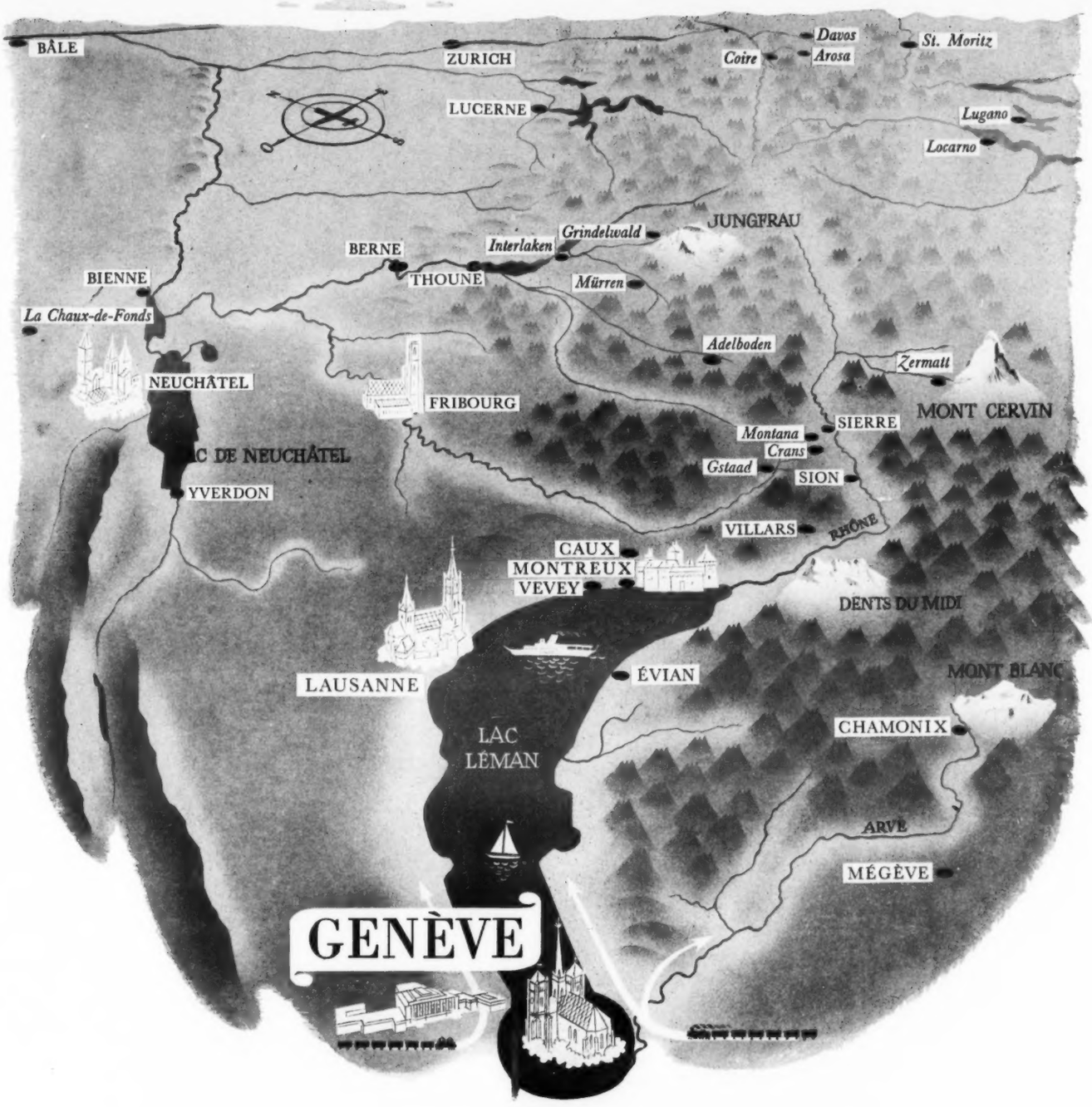

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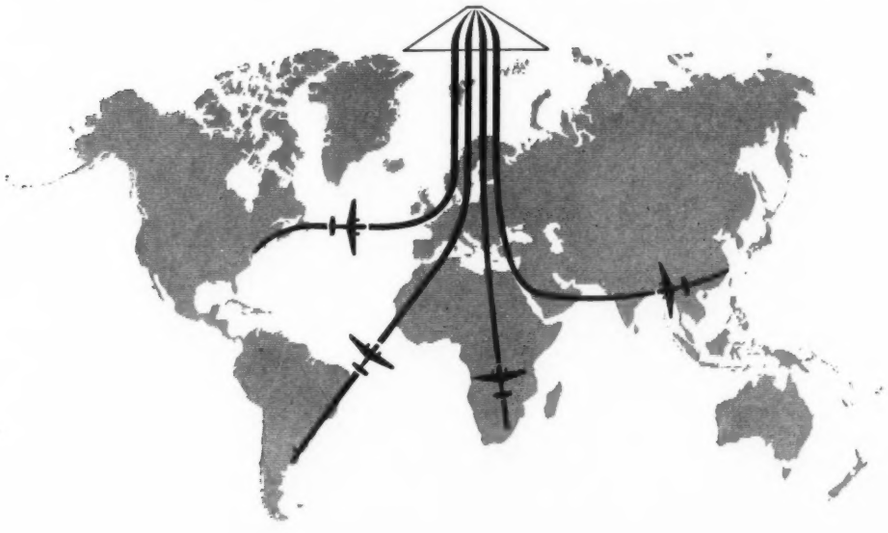

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